APPENDIX I

BROAD-SCALE HABITAT ANALYSES TO ESTIMATE FISH DENSITIES FOR VIABILITY CRITERIA

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Background

In this appendix, we describe a method for estimating quantities of currently and historically available habitat and for estimating fish densities implied by a range of viability criteria. We summarize results for the Willamette Lower Columbia (WLC) recovery domain. The rationale for examining implied fish densities for both currently and historically available stream miles is to consider the implications of a range of viability criteria on specific populations. These analyses can be used to answer the following questions:

- How much potential spawning or rearing habitat is currently accessible in particular watersheds for a given species of interest?
- How much potential spawning or rearing habitat might once have been available in particular watersheds for a given species of interest?
- Is a viability criterion reasonable given currently accessible habitat?
- Is a viability criterion reasonable given all historically available habitat?

The first step for many habitat-related recovery analyses is to estimate the amount of currently accessible and historically accessible habitat. These analyses provide an initial estimate of those quantities. One of the largest and most easily quantified anthropogenic changes to habitat quality or quantity has been the construction of large numbers of barriers to fish passage. Streams currently blocked to anadromous passage by a man-made barrier were historically available for spawning and rearing by multiple salmonid species. The first step in this analysis is to quantify the amounts and types of habitat that have been lost due to man-made barriers as a metric of habitat change. The results of this step form the building blocks for multiple additional analyses and are reported in detail here. The next step is to identify those habitat areas, currently and historically available, that are likely used by a particular species at a particular life stage. This classification might be based on mainstem versus tributary habitat, channel gradient, or other landform or land-use variables. The final step of our analysis is to calculate fish densities that would be necessary to meet potential, population-specific viability targets.

Methods

Stream Generation

One of the primary objectives of this analysis is to assess relative quantities and distribution of multiple types of habitat throughout the WLC domain. Because of the broad geographic range of the analysis, we required a Geographic Information System (GIS) stream network that was consistently available across all watersheds, but still of a fine enough resolution to discern differences in lengths of mainstem and tributary streams of varying widths. We determined that a 1:100,000 stream network (StreamNet 2001a) was not adequate to capture the stream features and measurements of interest. However, the available 1:24,000 stream networks were incomplete and used inconsistent methodologies.

We chose to generate 1:24,000 stream networks from 10-m drainage-enforced digital elevation models (DEMs), digital representations of three-dimensional terrain. Delineation and extraction of stream channel networks from DEMs is a well-represented procedure in practice and model development (Jenson and Domingue 1988, Tarboton et al. 1991, Montgomery and Foufoula-Georgiou 1993, Tarboton 1997). This technique uses drainage direction and flow accumulation (using slope and aspect from the DEM) across the landscape to delineate primary drainage and stream routes. Intuitively, the procedure can be described as estimating the location of the stream network by simulating the flow of water across the landscape. We chose a suite of programs called NetStream (Miller 2003) to assist us in generating a GIS-compatible, 1:24,000 spatial stream network. NetStream optimizes the resolution of low-order channels and can break the stream into topographically homogeneous segments or reaches based on DEM-derived valley width and channel gradient.

We generated streams for 17 fourth-field hydrologic units within the WLC domain. The watersheds were chosen based on distribution of Endangered Species Act (ESA) listed salmonid species and the extent of distinct populations (Myers et al. draft) within each evolutionarily significant unit (ESU). We performed quality control on the stream networks using other GIS stream network data sets. Stream channels were adjusted or regenerated where necessary. The NetStream program modeled approximately 111,780 km of streams at this scale for the 17 watersheds of interest. These were broken into 1.8 million stream segments or stream reaches. Reach length was 50 to 300 m, with a mean of 76 m. Reach length varied with upstream drainage area; larger rivers have larger drainage areas and less geomorphic variation so typically have longer reach lengths (Miller 2003). For example, in the Mollala-Pudding watershed, the model generated 4,108 km of stream, broken into 59,801 stream-reach segments. The same watershed at a lower resolution (1:100,000) is represented by only 1,708 km of stream. Because segments were identified based on tributary junctions and homogeneity in channel gradient, they are very similar in size and character to stream reaches that might be identified during field surveys. The similarity to field-derived reaches, and the small maximum size of the stream segments, is a strength of this analytical approach; habitat characteristics estimated for each reach will not be averaged over a long heterogeneous length of stream.

Computing limitations made it necessary for us to reduce both the number of stream segments and total segment length in the analysis. We clipped the drainage network to include only contiguous stream segments with a channel gradient of less than 20%. This clipping, or "pruning," of the drainage network reduced the number of stream segments by about 50% while effectively removing only the smallest-order streams, which are rarely, if ever, used by anadromous fish (Washington Forest Practices Board 2000). All further analyses were conducted on the pruned network.

NetStream calculated additional stream and habitat attributes based on the 10-m DEM (Table I.1). Channel gradient and valley floor widths were estimated for each segment. Given channel width (see next section), valley floor width can be used to determine whether the channel is constrained or unconstrained. Valley side-slope was calculated separately for each side of the river, averaging the gradient over the nearest 10 m from the edge of the channel and the nearest 100 m from the edge of the channel. (For further details on the NetStream program, see Miller 2003.) In the future, valley side-slope gradient and additional debris-flow modeling functionality in the NetStream program may be used to predict channel-bank stabilization measures and probability of landslides or debris flows. Modeled attributes not used in our immediate analysis may be used in future efforts to link landscape processes to in-stream habitat features and in-stream habitat conditions to fish densities.

Width Modeling

Fish use of habitat types is expected to vary by stream width. For example, pools in mainstem habitats might be expected to have higher densities of juvenile chinook than pools in tributaries. Several research groups have had good success modeling stream width using a combination of basin areas, channel gradients, and annual precipitation (Miller et al. 1996, Holsinger 2001, Hyatt et al. 2002, Clarke 2001).

Using simple linear regression analysis, we built a series of watershed-specific, stream-width models using existing habitat survey information from the Oregon Department of Fish and Wildlife (ODFW) Aquatic Inventories Project (AIP) (ODFW 2001a, Moore et al. 1999). These data sets contained measured channel width, as estimated at bankfull stage, for a total of 3,142 stream reaches. Reaches sampled by ODFW were 6,781 m long on average. Surveyed reaches were distributed fairly well throughout the Willamette and Lower Columbia watersheds in Oregon, and were available for 13 of the 17 fourth-field watersheds of interest. There was a greater emphasis on the smaller tributaries in the Willamette Basin (Figure I.1). We were unable to include data for watersheds on the Washington side of the Columbia River or on U.S. Forest Service lands because of data compatibility issues. Potential predictor variables for the stream-width models were from remotely sensed data and included basin area, average precipitation, and channel gradient. We plan to improve our stream-width modeling with recently updated AIP stream-reach data available for six of these watersheds from ODFW.

Stream width was modeled separately for the 13 watersheds with available data and for the entire WLC domain at once. Model fit varied dramatically between basins as a result of the distribution of field-surveyed reaches within the basin ($0.15 < R^2 < 0.76$). Model fit for all watersheds combined was adequate ($R^2 = 0.41$) but not as strong as identified in other smaller-scale or more field-intensive efforts. In most watersheds, stream reaches with a basin area smaller than 1 km^2 were removed from the analysis because they had such a strong effect on estimated parameters that the model did not fit the larger streams well. All watershed models included basin area, most included precipitation, and a few included channel gradient (Table I.2). Several models also included a multiplicative interaction between basin area and precipitation. A significant interaction term suggests that the effect of precipitation on stream width varied for smaller versus larger streams. In watersheds where the watershed-specific model fit was worse than the overall model fit, we used either of two alternative models. If there was an adjacent watershed within the same ecoregion with a better model fit and similar geology and topography, we used the model for that adjacent watershed. Where there were no adjacent watersheds with similar attributes and better model fits, we used the overall model to predict stream width in the watershed with a weak model fit.

We are in the process of testing the stream-width models. We plan to use a Monte Carlo approach to estimate predictive uncertainty. We may also be able to use the distribution of survey reaches to correct model predictions. In the interim, we are dividing the modeled widths into four categories based on similar work conducted in Puget Sound (Beamer 2001). These categories are large main stem (> 25 m), small main stem (10–25 m), large tributary (5–10 m), and small tributary (< 5 m). Initial results are presented in Figure I.2.

Barriers

As in much of the Pacific Northwest, one of the major habitat alterations in the WLC domain has been the placement of barriers to upstream and/or downstream migration. Barriers—including dams, diversions, and culverts—can partially or fully block fish passage. We collected information on in-stream barriers to fish migration in order to identify accessible and inaccessible river segments. We identified and coordinated nine digital databases containing information on the location and passage of natural and anthropogenic barriers (summarized in Table I.3). Because the data were compiled from multiple sources, the positional accuracy and passage information varied. Originally, there were over 10,000 potential barriers in the combined data set. After removing duplicates, clipping data to our watershed boundaries, and removing barriers located on streams not present in our stream network, we included over 2,600 potential barriers. To estimate habitat changes resulting from barriers, we identified all river segments in our analysis as accessible, inaccessible due to a man-made barrier, or inaccessible due to natural barriers (Figure I.3).

We used a variety of methods to categorize barriers as passable, impassable, or partially passable. These included GIS coverages of current fish distribution (Streamnet 2001b), maps of historical fish distribution, nonspatial databases, personal communications with state agencies, and (since height was one attribute available for most of the barriers) published limits to fish passage by barrier height (Myers et al. 2002; Aaserude 1984). Uncertainty in these classifications remains because positional inaccuracy of some barriers prevented us from associating them with the stream network (even though they may be barriers to fish passage), and because many barriers do not have complete passage information (Table I.3). Where passage was unknown or incomplete, we classified the barrier as passable; therefore, our analysis represents a conservative estimate of inaccessible stream habitat for most watersheds. Once the barriers were classified, all downstream and upstream stream segments were identified with the appropriate barrier passage codes, which were then summarized to simplified stream accessibility codes, as represented in Figure I.3. Individual barriers within the WLC block from 1 to 2,000 km of stream each. Local biologists reviewed the stream accessibility maps; they were requested to indicate erroneously classified streams within their respective geographic regions of expertise. Reviewers were asked to focus primarily on map errors (> 3 km) likely to impact general, broad-scale accessibility ratios for the watershed. All changes indicated by the biologists were incorporated into the final maps and summaries (Nusum 2002, Meyer 2002, Shively 2002, Stearns 2002[1]).

Future work conducting field inventories and developing statistical techniques for this type of spatial data will be required to reduce and display the uncertainty in our analysis. We also plan to incorporate newly available data. Spatial data (at a scale of 1:24,000) on fish distribution and passage and locations of culverts and dams has recently become available for Washington State (SSHIAP 2002) and has been incorporated in the final stream accessibility data. Updated fish distribution and barrier passage information has recently become available in Oregon (ODFW 2001, BLM 2000). These data will also be incorporated for specific watersheds as required by future studies. Eventually, we will quantify and display any remaining uncertainty about whether each stream segment is accessible to each species of concern.

Identification of Prime and Possible Habitat Attributes

Fish use of particular stream reaches is based on a host of habitat characteristics including nutrient status, channel gradient, substrate, cover, flow, water depth, and channel width. For this large-scale analysis, we needed to identify those areas most likely to be used by fish based on habitat characteristics we could identify from data available over the entire WLC. We surveyed eight local fisheries biologists to identify the suite of habitat characteristics that might indicate prime or possible habitat for each listed species at each relevant life stage. For steelhead and chinook, channel gradient was the best available habitat characteristic for classifying stream reaches in a way that would suggest whether the reach might be used for spawning and/or rearing. Ideally, we would have been able to use several of the other measured or modeled characteristics such as channel width or riparian vegetation; however, no quantitative thresholds could be determined for these characteristics. By combining local biologists' responses, we created a series of gradient thresholds describing prime and possible spawning and rearing habitat for each species (Figure I.4, Table I.4). For chum salmon, we identified a gradient cutoff to use initially (Table I.4) and a set of rules based on channel width and distance upstream from a tributary junction that can eventually be used as the basis of a better classification system. Further spatial analyses and programming will be required to implement these chum classification rules using our modeled channel width. While this is an extremely rough guide, it does help us to eliminate from our analyses those segments that are much less likely to be used by a particular species at a particular life stage.

[1] Nusum, M. 2002, personal communication—map review, Oregon Department of Fish and Wildlife South Willamette Watershed District Office, 7118 NE Vandenberg Avenue, Corvallis, OR 97330. Meyer, K., 2002, personal communication—map review, Cowlitz Valley Ranger District Fisheries Biologist, Gifford Pinchot National Forest, 10024 US Hwy 12, Randle, WA 98377. Shively, D., 2002, personal communication—map review, Fisheries Program Manager, Mt. Hood National Forest, 16400 Champion Way, Sandy, OR 97055. Stearns, C., 2002, personal communication—map review, Fisheries Biologist, Washington Department of Fish and Wildlife, 600 Capitol Way North, Olympia, WA 98501-1091.

Results

Available Stream Kilometers by Population

Currently and historically accessible, prime and possible stream kilometers are summarized for each population in the WLC ESUs in Tables I.5 through I.19. Summaries in these tables represent those reaches that meet prime or possible spawning criteria and include streams to the upper limits of the clipped stream coverage. These streams are further divided by our modeled width categories (Figures I.5 through I.8). For each population, these tables provide estimates of the amount of currently available habitat of different types, the amount of habitat that has been cut off from anadromous fish passage, and the proportion of prime versus possible spawning habitat. Direct distance comparisons between these numbers and distances based on 1:100,000 stream measurements are not appropriate because of increased sinuosity and numbers of tributaries represented by our 1:24,000 stream measurements.

Both currently and historically, a large fraction of the available habitat that meets basic geomorphic criteria (e.g., gradient) is unsuitable for use because of issues of habitat quality, for example high water temperature, inadequate flow, or large deposits of fine sediments (Reeves 1995). The goal of this analysis is to estimate changes in habitat quantity over a very large area in a consistent manner. The true amount of usable habitat, including issues of habitat quality, may be only 40 to 60% of the habitat areas that meet the basic access and suitability criteria specified in our analysis. The percentage of potentially suitable habitat affected by habitat quality issues is likely not the same currently as it was historically. Our numbers are therefore likely to be overestimates of available habitat and underestimates of habitat loss. Until analyses are available that can include these more detailed issues, the results presented here provide a reasonable index of habitat change and numbers that are useful for making comparisons across watersheds and populations.

These data may be used to evaluate many other questions. For example, one might compare the kilometers of prime or possible habitat available to particular species within a given watershed (Table I.20). Such comparisons can aid in efforts to provide for multispecies recovery. Spatial identification of areas that are prime spawning or rearing habitat for multiple species could be used in prioritizing areas or barriers for restoration actions. Additional habitat criteria, such as width of riparian buffer will improve the usefulness of these estimates for answering additional questions.

Implied Fish Densities at Viability Thresholds

Ideally, we would like to estimate abundance viability criteria based on current and historical habitat capacity. However, as described above, the number of stream kilometers accessible to a particular population is highly uncertain. That uncertainty is compounded by a wide range of potential average and maximum fish densities in particular habitat types. Questions about the fraction of potentially suitable habitat made unsuitable by habitat quality issues further decrease our ability to estimate habitat capacity directly using currently available analysis tools. For example, we do not know the extent of thermal degradation or toxic contamination, nor do we know how these habitat impacts affect fish density in particular habitat types. However, there remains a great need to relate abundance viability criteria to current, historical, and potential habitat quantities.

We use the habitat inventory to examine the implied fish densities of a range of abundance viability criteria (Tables I.21 through I.23). In this way, it will be possible to evaluate the feasibility of abundance viability criteria using current, historical, and potential habitat quantities, without diluting the habitat information with uncertainty about current or historical fish densities or capacities. Ideally, we would also like to assess the degree of habitat quality required to achieve the implied densities over current or potential habitat quantities. Fish densities estimated from our habitat inventory describe the average density required over a large area. Naturally, many habitat units that are suitable based on geomorphic criteria (e.g., gradient) would be unsuitable at a particular time because of issues of habitat quality (e.g., temperature, sediment composition, flow). This natural spatial variability in habitat quality increases required fish densities in the most suitable areas. Since our analyses describe the average fish density required, the more variability in the system (the more areas with low maximum fish densities), the higher the required fish densities in the best areas. Anthropogenic reductions in habitat quality (e.g., temperature, flow, sediment, toxics) would further increase fish densities required in the best remaining areas to meet population viability targets. Separate analyses identifying natural levels of habitat quality reductions, the spatial extent and degree of anthropogenic reductions in habitat quality, and effects of changes in habitat quality on fish densities and life-stage specific survivals would all be required to refine our current estimates.

Estimating the implied fish densities of abundance population viability criteria requires two pieces of information: the habitat area and the number of fish required to meet the abundance target. The implied fish density is simply the viability target divided by area. For comparison, we evaluate the density of current populations, as estimated by this approach, for each of four habitat areas: currently available prime, currently available possible, historically available prime, and historically available possible (Table I.22). Current abundance values are the average of the four most recent years of spawner counts. Some of the current abundance values may contain hatchery-origin spawners, as data did not always allow for distinction of natural- and hatchery-origin spawners.

We next evaluate five viability criteria across all four habitat area definitions: currently available prime, currently available possible, historically available prime, and historically available possible (Tables I.22 and I.23). Population definitions, current abundance estimates, and viability criteria under each of three scenarios are taken from Appendix E. Population criteria that we evaluated were developed from three scenarios that vary in their inclusion of hatchery fish and their projections of marine survival. Scenario 1 is based on extinction probabilities of declining to a four-year annual average of 50 spawners, calculated using population prediction intervals with 20 degrees of freedom for the variance estimate. The point estimate of the variance used to generate these targets is 0.05. The targets in scenario 1 assume that there are 0 hatchery-origin spawners present in any of the populations in the next 20 years. These targets also assume that the average of the marine survival index in the next 20 years is equal to long-term average marine survival (Table I.22). We evaluated two different extinction probabilities for this scenario (5% and 15%). Scenario 2 is identical, except that targets assume 5% of the spawners are of hatchery origin in every population over the next 20 years. The actual target size is still expressed in terms of natural-origin spawners. As in scenario 1, targets in scenario 2 assume that the average of the marine survival index in the next 20 years will be equal to the long-term average marine survival. Targets in scenario 3 assume that there are zero hatchery-origin spawners present in any of the populations in the next 20 years (Table I.23), but scenario 3 targets assume that the average of the marine survival index in the next 20 years is 20% higher than the long-term average marine survival (Table I.23). Targets in scenario 4 assume both a hatchery influence and a change in marine survival. These targets assume that 5% of the spawners are of hatchery origin in every population over the next 20 years. Again, the target size is expressed only in terms of natural origin spawners. Scenario 4 targets also assume that the average of the marine survival index in the next 20 years is 20% higher than the long-term average marine survival (Table I.23). These scenarios are described in detail in Appendix D (Tables D.3 through D.6).

The implied fish densities presented here should be compared to ranges of species-specific fish densities from field observations, published literature, and/or historical records. A first step in evaluating this methodology will be to compare the estimates of current fish density to field observations. The fish densities under each of the viability criteria can be evaluated for their reasonableness: “Would it be reasonable to expect that we could observe average fish densities of this magnitude in this watershed?” If so, current habitat may be of sufficient quantity to support a population as large as the abundance criteria require. The habitat may not be of sufficient quality; this question should be addressed in separate analyses. The implied average fish density, given all historically available habitat, suggests whether the criteria are reasonable given all habitat that a population once used. If the implied average fish density over all historically available habitat is much higher than anything one might expect to see in the field, we have an indication that the criteria may be too high. As well as evaluating criteria, we can use the tables to examine the potential impact of reconnecting currently inaccessible habitat by comparing fish densities for currently and historically available habitats. Increasing the number of habitat quality predictors would make important refinements in these predictions. We have not divided the density estimates according to channel-width categories, but it would be possible to do so based on estimates of the proportion of spawning in large main stems, small main stems, large tributaries, and small tributaries for each species.

Conclusion

The broad-scale habitat inventory provides a method for making comparisons across and between ecoregions, watersheds, and ESUs. The first step of the analysis, a detailed inventory of habitat types, classified by accessibility, provides the building blocks for multiple recovery-related habitat analyses. Here it is used to estimate the implied fish densities of a range of abundance viability criteria. Implied densities from a range of future population scenarios can be evaluated with respect to species-specific fish densities from field observations, published literature, or historical records. There is uncertainty associated with our estimates of current and potential stream kilometers, as well as with our classification of prime versus possible habitat; we have identified and minimized these sources of uncertainty. In future analyses, we will also attempt to quantify the uncertainty. The inventory approach has a wide range of additional applications including estimating habitat quantities above individual passage barriers and developing models of in-stream habitat characteristics from landscape-scale digital data.

Table I.1 Reach-level channel attributes derived from drainage elevation models.

Landscape Derived/Modeled Stream Attributes	
Flow accumulation / drainage area	Steepest reach downstream (gradient)
Reach-averaged stream gradient	Left/right channel side-slope (~ 10 m)
Stream order (Strahler)	Left/right channel side-slope (~ 100 m)
Stream reach length	Left/right side valley floor width (m)
Mean annual precipitation depth (mm)	Lake or stream

Table I.2 Statistical models to predict stream width in 13 watersheds in the Willamette/Lower Columbia domain.

Watershed Name	Fourth-Field HUC[a]	INT[b]	AREA[b]	GRAD[b]	PRECIP[b]	BA*P[c]	R^{2d}	Small Streams Excluded[e]
Middle Columbia-Hood	70105	-1.39	0.52		0.0008		0.75	yes
Lower Columbia-Sandy	80001	0.65	0.42		0.0002		0.76	yes
Lower Columbia-Clatskanie	80003	1.58	0.25				0.15	
Lower Columbia	80006	2.54	0.17		-0.0007		0.29	
Middle Fork Willamette	90001	1.72	0.15	-2.71			0.38	yes
Upper Willamette	90003	0.81	0.23		0.0002		0.30	
McKenzie	90004	0.12	0.67		0.0006	-0.0002	0.62	
North Santiam	90005	3.02	-0.73		-0.0006	0.0004	0.41	
South Santiam	90006	4.45	-0.90	-1.42	-0.0013	0.0006	0.71	
Middle Willamette	90007	1.07	0.39				0.50	
Tualatin	90010	0.58	0.31		0.0004		0.35	
Clackamas	90011	0.61	0.52				0.62	
Lower Willamette	90012	-0.98	0.29		0.0014		0.63	
All watersheds[f]		1.10	0.29		0.0001		0.41	

[a] HUC = hydrologic unit codes

[b] The columns intercept (INT), basin area (AREA), channel gradient (GRAD), and precipitation (PRECIP), describe potential predictor variables. If they are included in the final model for a particular watershed, the coefficient is presented in that column.

[c] Basin Area * Precipitation (BA*P) describes an interaction term. If it was included in the final model, a coefficient is presented in that column. Basin area was log-transformed in all cases.

[d] The R^2 value presented is the multiple R^2 value.

[e] This column indicates whether streams within basin areas smaller than 1 km^2 were excluded from the analysis.

[f] This row describes a model for all watersheds combined.

Table I.3 Barrier databases used to delineate accessible and inaccessible stream segments.

Data Set[a]	Date Received	Source Date	Data Extent	No. Points (Not Always Unique)	Barrier Type	Passage-Related Information
Mthoodbarriers	06/01	6/1994	Mt. Hood National Forest, Oregon	124	Natural Artificial	No
Batemanbarriers	09/01	03/2000	Willamette Valley, coastal Oregon	635	Natural Artificial	Yes
BPA	10/01	10/2001	Washington, Oregon, Idaho, Montana	2,384 (326 in WLC)	Artificial	Limited
Wvndams	06/01	2000	Willamette Valley, coastal Oregon	213	Artificial	Yes
Wvncbars	10/01	02/2000	Willamette Valley, north coastal Oregon	709	Artificial Natural	Yes
ODFW dams and fishways	07/01	1998	Oregon	744	Artificial Natural	Yes
Mvbdams	06/01	1995	Oregon, Washington, Idaho, Montana, Nevada	9,707 (1,030 in WLC)	Artificial	No
ORCulverts (three files)	05/01	1995	Western Oregon	4,267 (2,349 in WLC)	Artificial	Limited
WaBarriers	09/01	1999	Washington	3,365 (180 in WLC)	Artificial Natural	Limited
NewWaBar	2002	03/2002 data recalled	SW Washington (WRIA[b] 24, 25, 26, 27, 28, 29)	2,011	Artificial Natural	Yes

[a] Key to barriers databases:

Mthoodbarriers = Barriers in Mt. Hood National Forest (USFS 1994)

Batemanbarriers = Natural and man-made barriers to fish passage, western Oregon (Gresswell and Bateman 2000)

BPA = BPA dams and possible hydro sites (BPA 2001)

Wvndams = Western Oregon dams/barriers (StreamNet 2000)

Wvncbars = Western Oregon dams/barriers (StreamNet 2000)

ODFW dams and fishways = Nonspatial database from ODFW with fishway information (ODFW 2000)

Mvbdams = Interior Columbia Ecosystem Management Project (ICBEMP) from U.S. Army Corps of Engineers (Quigley et al. 2001)

ORCulverts = Culvert locations and passage info from Charlie Corrarino, ODFW Fish passage division (ODFW 2001b)

WaBarriers = Washington State man-made and natural barriers. Original data from Martin Hudson, WDFW; will be superseded by new Washington SSHIAP data (WDFW 1999).

NewWaBar = Washington barriers: New SSHIAP barrier data for southwest Washington (SSHIAP 2002)

[b] WRIA = Water Resource Inventory Area

Table I.4 Gradient ranges for prime and possible habitat by species and life stage.[a]

Species		Spawning	Rearing
Possible			
	Chinook salmon	0.5–4%	0.5–3%
	Steelhead	0.5–4% (summer)	0–7% (summer)
		0.5–6% (winter)	1.5–7% (winter)
	Chum salmon	0–3.5%	
Prime			
	Chinook salmon	1–2%	1–2%
	Steelhead	3–4% (summer)	1–3% (summer)
		1–5% (winter)	1.5–7% (winter)

[a] Based on interviews with Mark Wade, Oregon Department of Fish and Wildlife (ODFW), 90700 Fish Hatchery Road, Leaburg, OR 97489; Jeff Ziller, ODFW, Springfield Field Office, 3150 East Main St Springfield, OR 97478-5800; Gary Galovich, ODFW, South Willamette Watershed District Office, 7118 NE Vanderberg Avenue, Corvallis, OR 97330-9446; Kurt Schroeder and Ken Kenniston, ODFW, Corvallis Research Lab, 28655 Highway 34 Corvallis, OR 97333; Wayne Hunt, ODFW, Salem Field Office, 4412 Silverton Road NE Salem, OR 97305-2060; Steve Cramer, S.P. Cramer and Associates, Inc., 39330 Proctor Blvd., Sandy, OR 97055; Pat Connelly, U.S. Geological Survey, Columbia River Research Lab, 5501-A Cook-Underwood Rd., Cook, WA 98605; Joe Hymer, Washington Department of Fish and Wildlife, Region 5 Office, 2108 Grand Boulevard, Vancouver, WA 98661.

Table I.5 Accessible and inaccessible prime spawning kilometers for fall chinook populations in the Lower Columbia ESU by stream-width category.

Population	Stream Size[a]	Accessible	Inaccessible Due to Man-made Barriers	Inaccessible Due to Natural Barriers	Partially Accessible Due to Man-made Barriers	Partially Accessible Due to Natural Barriers	Unknown
Kalama	Main stem (sm)	11.77	0.00	2.28	0.00	0.00	0.00
	Tributary (lg)	7.44	0.20	2.51	0.00	0.00	0.00
	Tributary (sm)	5.06	0.39	3.13	0.04	0.00	0.00
Lewis Salmon	Main stem (lg)	0.86	0.33	0.00	0.00	0.00	0.00
	Main stem (sm)	13.52	8.12	1.07	2.27	3.69	0.00
	Tributary (lg)	26.38	10.92	1.76	8.25	4.71	0.00
	Tributary (sm)	46.47	30.10	1.73	24.70	18.93	0.67
Big Creek	Main stem (sm)	2.98	5.04	0.00	0.00	0.00	0.00
	Tributary (lg)	2.55	2.49	0.00	0.00	0.39	0.00
	Tributary (sm)	22.07	1.88	0.00	0.00	0.36	0.00
Big White Salmon	Main stem (lg)	0.00	5.29	0.00	0.00	0.00	0.00
	Tributary (lg)	0.00	6.20	0.00	0.00	0.00	0.00
	Tributary (sm)	0.00	11.57	0.00	0.00	0.00	0.00
Clackamas	Main stem (lg)	2.77	0.00	0.00	0.00	0.00	0.00
	Main stem (sm)	26.70	0.00	1.01	0.00	5.40	0.00
	Tributary (lg)	14.75	0.00	1.85	0.15	4.43	0.11
	Tributary (sm)	121.81	14.95	5.12	6.03	4.41	0.93
Clatskanie	Main stem (sm)	11.84	0.00	1.95	0.00	0.00	0.00
	Tributary (lg)	12.04	0.12	11.96	0.49	0.00	0.55
	Tributary (sm)	17.55	0.00	15.96	0.00	0.00	0.79
Coweeman	Main stem (sm)	11.34	0.00	0.25	0.00	0.00	0.00
	Tributary (lg)	4.75	1.98	2.18	0.00	0.00	0.00
	Tributary (sm)	3.33	0.56	1.53	0.07	0.00	0.00
Cowlitz	Main stem (lg)	1.28	2.25	0.00	0.00	0.00	0.00
	Main stem (sm)	14.67	32.89	5.71	0.00	1.37	0.00
	Tributary (lg)	36.69	42.50	18.62	0.00	4.48	0.00
	Tributary (sm)	70.39	75.43	18.47	0.00	8.66	0.67
Elochoman	Main stem (sm)	3.68	0.00	0.00	0.00	0.00	0.00
	Tributary (lg)	11.46	2.59	0.00	0.00	0.00	0.16
	Tributary (sm)	12.62	5.88	0.00	0.00	0.00	0.11
Grays	Main stem (sm)	7.16	0.00	0.00	0.00	0.00	0.00
	Tributary (lg)	16.49	0.00	1.48	0.00	0.00	0.00
	Tributary (sm)	21.62	0.00	3.83	0.00	0.00	0.00
Hood	Main stem (lg)	5.38	0.00	0.00	0.89	0.00	0.00
	Main stem (sm)	0.00	0.00	0.00	1.55	1.84	0.00
	Tributary (sm)	3.05	0.00	0.00	2.06	0.13	0.00
Lower gorge tributaries	Main stem (sm)	1.46	0.00	0.00	0.00	0.00	1.28
	Tributary (lg)	1.93	0.00	0.00	0.51	0.00	0.30
	Tributary (sm)	7.24	0.21	0.18	0.45	0.00	0.05
Mill	Main stem (sm)	15.09	0.00	1.73	0.00	0.00	0.00
	Tributary (lg)	11.32	0.00	3.91	0.00	0.00	0.00
	Tributary (sm)	10.73	1.44	5.38	0.00	0.00	0.11

Table 1.5 cont.

Population	Stream Size[a]	Accessible	Inaccessible Due to Man-made Barriers	Inaccessible Due to Natural Barriers	Partially Accessible Due to Man-made Barriers	Partially Accessible Due to Natural Barriers	Unknown
Sandy	Main stem (lg)	17.13	0.13	0.00	10.17	0.00	0.00
	Main stem (sm)	11.73	7.67	0.25	0.00	0.00	1.92
	Tributary (lg)	7.96	1.90	0.90	1.84	0.00	3.46
	Tributary (sm)	15.18	9.44	0.70	8.66	0.00	3.60
Scappoose	Main stem (lg)	0.06	0.00	0.00	0.00	0.00	0.00
	Main stem (sm)	4.93	0.00	0.00	0.00	0.31	0.00
	Tributary (lg)	13.53	3.13	3.71	0.00	8.53	0.00
	Tributary (sm)	34.31	7.98	4.65	2.71	7.12	0.12
Toutle	Main stem (lg)	8.97	0.00	0.00	0.00	0.00	0.00
	Main stem (sm)	18.54	9.18	1.11	0.36	1.23	0.63
	Tributary (lg)	12.44	7.21	7.14	1.99	0.04	1.89
	Tributary (sm)	21.27	14.41	6.67	6.59	0.05	1.07
Upper gorge tributaries	Main stem (lg)	0.00	0.00	0.00	0.00	0.30	0.00
	Main stem (sm)	0.84	0.99	5.82	0.00	0.13	0.13
	Tributary (lg)	0.79	0.45	1.80	0.00	0.00	0.00
	Tributary (sm)	4.73	0.00	6.25	0.00	0.00	0.00
Washougal	Main stem (lg)	2.48	0.00	0.00	1.28	0.43	0.00
	Main stem (sm)	0.94	1.86	0.52	4.01	3.14	0.00
	Tributary (lg)	1.14	8.78	0.50	2.17	2.63	0.00
	Tributary (sm)	2.62	14.11	0.31	2.50	1.55	0.00
Youngs	Main stem (sm)	5.67	5.57	5.84	0.00	0.50	0.00
	Tributary (lg)	12.48	0.21	6.85	0.00	0.00	0.82
	Tributary (sm)	38.11	0.38	1.74	0.00	0.11	0.54

[a] Main stem (lg) > 25 m; main stem (sm) 10–25 m; tributary (lg) 5–10 m; tributary (sm) < 5 m.

Table I.6 Accessible and inaccessible possible spawning kilometers for fall chinook populations in the Lower Columbia ESU by stream width category.[a]

Population	Stream Size[a]	Accessible	Inaccessible Due to Man-made Barriers	Inaccessible Due to Natural Barriers	Partially Accessible Due to Man-made Barriers	Partially Accessible Due to Natural Barriers	Unknown
Kalama	Main stem (sm)	30.39	0.00	6.04	0.00	0.00	0.00
	Tributary (lg)	26.26	2.34	11.58	0.00	0.00	0.39
	Tributary (sm)	20.91	2.76	11.00	0.18	0.00	0.45
Lewis Salmon	Main stem (lg)	2.53	2.42	0.00	0.00	0.00	0.00
	Main stem (sm)	36.66	30.24	3.36	8.17	8.46	0.00
	Tributary (lg)	74.13	33.04	7.75	19.13	19.73	0.00
	Tributary (sm)	149.13	94.52	9.68	68.26	51.88	1.59
Big Creek	Main stem (sm)	8.72	9.31	0.00	0.00	0.00	0.00
	Tributary (lg)	14.67	17.28	0.00	0.00	3.40	0.00
	Tributary (sm)	63.56	10.31	0.00	0.00	1.72	0.00
Big White Salmon	Main stem (lg)	0.33	12.69	0.00	0.00	0.00	0.00
	Tributary (lg)	0.00	11.56	0.00	0.00	0.00	0.00
	Tributary (sm)	0.00	46.35	0.00	0.00	0.00	0.00
Clackamas	Main stem (lg)	18.56	0.00	0.00	0.00	0.00	0.20
	Main stem (sm)	48.87	0.00	7.97	0.00	10.34	0.00
	Tributary (lg)	44.22	0.00	14.15	0.15	16.18	0.60
	Tributary (sm)	379.73	45.28	17.55	24.06	25.83	4.83
Clatskanie	Main stem (sm)	27.32	0.00	4.87	0.00	0.00	0.00
	Tributary (lg)	43.63	0.12	34.54	2.31	0.00	4.42
	Tributary (sm)	84.26	0.00	57.49	1.19	0.00	3.59
Coweeman	Main stem (sm)	27.16	0.00	0.95	0.00	0.00	0.00
	Tributary (lg)	17.98	6.75	6.79	0.00	0.00	0.00
	Tributary (sm)	15.96	3.06	6.48	0.19	0.00	0.00
Cowlitz	Main stem (lg)	4.94	12.37	0.00	0.00	0.00	0.00
	Main stem (sm)	35.10	107.40	44.81	0.00	4.67	0.00
	Tributary (lg)	100.66	134.61	68.93	0.00	12.90	0.00
	Tributary (sm)	229.32	246.44	65.89	0.00	30.47	1.68
Elochoman	Main stem (sm)	9.60	0.25	0.00	0.00	0.00	0.00
	Tributary (lg)	35.79	10.54	0.00	0.00	0.00	0.59
	Tributary (sm)	39.97	19.42	0.00	0.00	0.00	0.28
Grays	Main stem (sm)	21.44	0.00	0.00	0.00	0.00	0.00
	Tributary (lg)	46.38	0.00	5.01	0.00	0.00	0.00
	Tributary (sm)	64.70	0.00	10.28	0.00	0.00	0.00
Hood	Main stem (lg)	10.77	0.00	0.00	1.99	0.00	0.00
	Main stem (sm)	0.00	0.00	0.00	1.55	2.63	0.00
	Tributary (sm)	8.04	0.00	0.00	8.62	1.49	0.06
Lower gorge tributaries	Main stem (sm)	5.50	0.00	0.00	0.00	0.00	5.50
	Tributary (lg)	4.26	0.00	0.31	1.65	0.00	1.03
	Tributary (sm)	21.07	0.45	0.56	1.83	0.00	0.94
Mill	Main stem (sm)	26.67	0.00	3.65	0.00	0.00	0.00
	Tributary (lg)	43.17	0.36	13.33	0.00	0.00	0.00
	Tributary (sm)	47.61	4.98	18.80	0.00	0.00	0.66

Table 1.6 cont.

Population	Stream Size[a]	Accessible	Inaccessible Due to Man-made Barriers	Inaccessible Due to Natural Barriers	Partially Accessible Due to Man-made Barriers	Partially Accessible Due to Natural Barriers	Unknown
Sandy	Main stem (lg)	43.55	0.29	0.00	21.85	0.00	0.00
	Main stem (sm)	55.30	23.07	2.65	0.15	0.00	7.85
	Tributary (lg)	26.64	9.06	2.87	3.48	0.00	17.67
	Tributary (sm)	53.92	26.25	2.85	22.21	0.00	14.35
Scappoose	Main stem (lg)	0.61	0.00	0.00	0.00	0.00	0.00
	Main stem (sm)	7.24	0.00	0.00	0.00	0.78	0.00
	Tributary (lg)	33.88	7.59	9.89	0.00	16.85	0.00
	Tributary (sm)	105.93	27.44	17.26	7.62	24.93	0.70
Toutle	Main stem (lg)	20.78	0.00	0.00	0.00	0.00	0.00
	Main stem (sm)	49.66	23.26	4.15	0.81	2.22	1.98
	Tributary (lg)	38.01	23.72	26.15	6.35	0.98	6.12
	Tributary (sm)	75.16	49.09	27.72	22.73	0.26	4.92
Upper gorge tributaries	Main stem (lg)	0.87	0.00	0.00	0.00	1.09	0.00
	Main stem (sm)	2.31	2.89	16.47	0.00	0.37	1.87
	Tributary (lg)	1.02	1.13	6.31	0.00	0.00	0.37
	Tributary (sm)	17.01	0.25	24.35	0.00	0.00	0.00
Washougal	Main stem (lg)	5.78	0.00	0.00	2.17	2.06	0.00
	Main stem (sm)	3.81	8.05	0.97	9.46	8.98	0.00
	Tributary (lg)	2.28	22.00	2.38	8.98	10.94	0.00
	Tributary (sm)	11.90	49.70	1.00	9.25	8.46	0.00
Youngs	Main stem (sm)	18.54	11.55	15.37	0.00	1.64	0.00
	Tributary (lg)	35.94	0.60	20.61	0.00	0.29	3.89
	Tributary (sm)	121.68	4.43	17.20	0.00	0.28	2.63

[a] Main stem (lg) > 25 m; main stem (sm) 10–25 m; tributary (lg) 5–10 m; tributary (sm) < 5 m.

Table I.7 Accessible and inaccessible prime spawning kilometers for winter steelhead populations in the Lower Columbia ESU by stream width category.

Population	Stream Size[a]	Accessible	Inaccessible Due to Man-made Barriers	Inaccessible Due to Natural Barriers	Partially Accessible Due to Man-made Barriers	Partially Accessible Due to Natural Barriers	Unknown
Cispus	Main stem (lg)	0.00	3.10	0.00	0.00	0.00	0.00
	Main stem (sm)	0.00	38.84	61.72	0.00	0.00	0.00
	Tributary (lg)	0.00	2.98	70.74	0.00	0.00	0.00
	Tributary (sm)	0.00	15.08	69.28	0.00	0.00	0.00
Clackamas	Main stem (lg)	40.65	17.07	0.00	0.00	1.63	0.46
	Main stem (sm)	65.27	16.64	36.85	2.12	25.04	2.60
	Tributary (lg)	44.48	19.57	42.90	6.36	31.16	10.16
	Tributary (sm)	320.86	112.97	39.49	46.73	64.94	29.75
Coweeman	Main stem (sm)	21.03	0.00	0.85	0.00	0.00	0.00
	Tributary (lg)	19.37	7.31	6.88	0.00	0.00	0.00
	Tributary (sm)	19.28	4.69	7.57	0.39	0.00	0.00
East Fork Lewis	Main stem (sm)	14.52	0.00	3.70	0.00	9.98	0.00
	Tributary (lg)	42.79	7.43	4.33	5.86	16.18	0.00
	Tributary (sm)	68.15	53.07	4.74	5.69	10.65	1.01
Hood	Main stem (lg)	7.97	0.00	0.00	4.53	0.00	0.00
	Main stem (sm)	0.00	0.00	0.00	19.45	2.63	0.00
	Tributary (lg)	0.00	0.00	0.00	0.11	0.00	0.00
	Tributary (sm)	9.40	0.89	0.00	71.86	1.76	0.58
Kalama	Main stem (sm)	20.47	0.00	7.13	0.00	0.00	0.00
	Tributary (lg)	32.09	3.18	13.58	0.00	0.00	0.73
	Tributary (sm)	25.68	2.84	15.06	0.52	0.00	0.53
Lower Cowlitz	Main stem (lg)	1.71	0.30	0.00	0.00	0.00	0.00
	Main stem (sm)	22.50	3.28	1.94	0.00	0.35	0.00
	Tributary (lg)	74.82	21.09	7.93	0.00	8.43	0.00
	Tributary (sm)	234.64	60.46	4.24	0.00	35.53	1.90
Lewis	Main stem (lg)	0.86	1.62	0.00	0.00	0.00	0.00
	Main stem (sm)	6.27	104.50	0.00	0.00	0.00	0.00
	Tributary (lg)	19.59	96.29	2.07	0.00	2.34	0.00
	Tributary (sm)	40.59	93.87	8.34	0.00	10.21	0.00
Lower gorge tributaries	Main stem (sm)	5.33	0.00	0.14	0.00	0.00	6.38
	Tributary (lg)	4.49	0.00	0.40	1.53	0.00	1.63
	Tributary (sm)	19.02	0.21	0.47	2.17	0.00	1.82
North Fork Toutle	Main stem (lg)	9.32	0.00	0.00	0.00	0.00	0.00
	Main stem (sm)	17.44	17.51	2.90	0.36	2.50	1.42
	Tributary (lg)	22.47	20.72	21.78	6.64	0.58	4.48
	Tributary (sm)	59.73	48.53	27.58	23.64	0.44	3.82
Salmon	Main stem (sm)	0.87	0.49	0.00	3.25	2.97	0.00
	Tributary (lg)	3.05	1.57	1.15	10.47	1.89	0.00
	Tributary (sm)	45.36	20.15	1.17	59.94	26.88	0.66
Sandy	Main stem (lg)	19.11	0.34	0.00	10.47	0.00	0.00
	Main stem (sm)	62.55	28.20	2.65	0.62	0.00	10.25
	Tributary (lg)	29.78	10.81	4.15	4.17	0.00	21.39
	Tributary (sm)	63.30	27.04	3.69	25.42	0.00	19.68

Table 1.7 cont.

Population	Stream Size	Accessible	Inaccessible Due to Man-made Barriers	Inaccessible Due to Natural Barriers	Partially Accessible Due to Man-made Barriers	Partially Accessible Due to Natural Barriers	Unknown
South Fork Toutle	Main stem (sm)	19.35	0.00	0.00	0.00	0.00	0.00
	Tributary (lg)	16.58	3.11	6.36	0.00	0.43	0.77
	Tributary (sm)	23.89	4.75	6.24	0.00	0.00	0.73
Tilton	Main stem (sm)	0.00	18.89	0.00	0.00	0.00	0.00
	Tributary (lg)	0.00	26.62	1.58	0.00	0.00	0.00
	Tributary (sm)	0.00	40.77	0.39	0.00	0.00	0.00
Upper Cowlitz	Main stem (lg)	0.00	0.70	0.00	0.00	0.00	0.00
	Main stem (sm)	0.00	62.39	41.93	0.00	4.19	0.00
	Tributary (lg)	0.00	58.41	58.69	0.00	0.62	0.00
	Tributary (sm)	0.00	125.20	42.31	0.00	0.00	0.00
Upper gorge tributaries	Main stem (sm)	2.28	0.00	16.53	0.00	0.00	2.65
	Tributary (lg)	0.10	0.00	5.01	0.00	0.00	0.71
	Tributary (sm)	18.99	0.00	29.02	0.00	0.00	0.00
Washougal	Main stem (lg)	3.65	0.00	0.00	1.92	1.75	0.00
	Main stem (sm)	1.81	2.87	0.86	10.15	5.98	0.00
	Tributary (lg)	2.19	19.73	2.56	11.21	12.46	0.00
	Tributary (sm)	13.98	53.36	1.71	10.60	11.26	0.00
Wind	Main stem (lg)	0.87	0.00	0.00	0.00	9.02	5.52
	Main stem (sm)	0.00	2.75	0.00	0.00	8.16	7.28
	Tributary (lg)	1.08	1.47	1.72	0.00	4.55	7.00
	Tributary (sm)	0.29	0.44	1.41	0.00	13.86	12.61

[a] Main stem (lg) > 25 m; main stem (sm) 10–25 m; tributary (lg) 5–10 m; tributary (sm) < 5 m.

Table I.8 Accessible and inaccessible possible spawning kilometers for winter steelhead populations in the Lower Columbia ESU by stream width category.

Population	**Stream Size**[a]	**Accessible**	**Inaccessible Due to Man-made Barriers**	**Inaccessible Due to Natural Barriers**	**Partially Accessible Due to Man-made Barriers**	**Partially Accessible Due to Natural Barriers**	**Unknown**
Cispus	Main stem (lg)	0.00	9.03	0.00	0.00	0.00	0.00
	Main stem (sm)	0.00	52.94	70.16	0.00	0.00	0.00
	Tributary (lg)	0.00	5.64	89.54	0.00	0.00	0.00
	Tributary (sm)	0.00	19.22	94.10	0.00	0.00	0.00
Clackamas	Main stem (lg)	92.79	17.07	0.00	0.00	1.89	0.65
	Main stem (sm)	87.13	18.84	40.22	2.69	33.88	3.07
	Tributary (lg)	68.86	24.47	54.24	9.11	40.42	14.69
	Tributary (sm)	428.48	146.86	58.24	59.89	94.13	38.92
Coweeman	Main stem (sm)	28.45	0.00	0.95	0.00	0.00	0.00
	Tributary (lg)	25.90	8.94	9.39	0.00	0.00	0.00
	Tributary (sm)	30.59	7.22	10.20	0.45	0.00	0.00
East Fork Lewis	Main stem (sm)	26.14	0.00	4.28	0.00	11.72	0.00
	Tributary (lg)	55.77	8.53	6.39	8.51	21.04	0.00
	Tributary (sm)	89.82	67.64	7.18	8.23	17.32	1.36
Hood	Main stem (lg)	11.11	0.00	0.00	5.58	0.00	0.00
	Main stem (sm)	0.00	0.00	0.00	20.03	2.63	0.00
	Tributary (lg)	0.12	0.00	0.00	1.08	0.08	0.00
	Tributary (sm)	13.05	0.89	0.00	82.05	1.86	0.68
Kalama	Main stem (sm)	33.53	0.00	8.59	0.00	0.00	0.00
	Tributary (lg)	41.79	4.76	17.44	0.08	0.00	0.97
	Tributary (sm)	36.25	5.37	21.33	0.58	0.00	0.67
Lower Cowlitz	Main stem (lg)	4.94	0.39	0.00	0.00	0.00	0.00
	Main stem (sm)	35.76	3.69	1.94	0.00	1.34	0.00
	Tributary (lg)	116.13	37.79	10.34	0.00	14.05	0.00
	Tributary (sm)	324.14	89.88	6.77	0.00	45.71	2.33
Lewis	Main stem (lg)	2.53	2.80	0.00	0.00	0.00	0.00
	Main stem (sm)	10.84	143.74	0.00	0.00	0.00	0.00
	Tributary (lg)	28.30	132.35	2.74	0.00	5.06	0.00
	Tributary (sm)	54.84	130.45	11.77	0.00	13.88	0.00
Lower gorge tributaries	Main stem (sm)	7.04	0.00	0.32	0.00	0.00	8.28
	Tributary (lg)	5.12	0.00	0.69	2.05	0.00	1.74
	Tributary (sm)	28.97	0.45	0.87	2.81	0.00	2.57
North Fork Toutle	Main stem (lg)	20.78	0.00	0.00	0.00	0.00	0.00
	Main stem (sm)	27.24	26.57	4.52	0.81	2.85	2.06
	Tributary (lg)	28.77	26.92	28.96	8.81	0.73	5.81
	Tributary (sm)	83.77	67.21	40.02	34.93	0.75	6.32
Salmon	Main stem (sm)	2.14	1.70	0.00	8.33	5.62	0.00
	Tributary (lg)	5.35	1.57	1.72	15.41	4.92	0.00
	Tributary (sm)	61.98	26.96	1.41	81.78	36.52	0.66
Sandy	Main stem (lg)	44.15	0.82	0.00	21.85	0.00	0.00
	Main stem (sm)	70.86	35.55	2.85	1.00	0.00	13.42
	Tributary (lg)	39.27	15.90	5.29	4.70	0.00	27.91
	Tributary (sm)	83.26	38.73	5.03	30.02	0.00	26.43

Table 1.8 cont.

Population	Stream Size[a]	Accessible	Inaccessible Due to Man-made Barriers	Inaccessible Due to Natural Barriers	Partially Accessible Due to Man-made Barriers	Partially Accessible Due to Natural Barriers	Unknown
South Fork Toutle	Main stem (sm)	26.34	0.00	0.00	0.00	0.00	0.00
	Tributary (lg)	23.09	4.11	8.59	0.00	0.77	1.42
	Tributary (sm)	31.37	6.44	8.69	0.00	0.00	1.23
Tilton	Main stem (sm)	0.00	27.05	0.00	0.00	0.00	0.00
	Tributary (lg)	0.00	38.02	2.35	0.00	0.00	0.00
	Tributary (sm)	0.00	55.13	0.55	0.00	0.00	0.00
Upper Cowlitz	Main stem (lg)	0.00	3.04	0.00	0.00	0.00	0.00
	Main stem (sm)	0.00	80.91	49.38	0.00	4.71	0.00
	Tributary (lg)	0.00	86.65	76.37	0.00	1.14	0.00
	Tributary (sm)	0.00	181.81	64.80	0.00	0.00	0.00
Upper gorge tributaries	Main stem (sm)	2.42	0.00	23.24	0.00	0.00	3.84
	Tributary (lg)	0.10	0.00	6.75	0.00	0.00	0.82
	Tributary (sm)	28.56	0.00	36.73	0.00	0.00	0.00
Washougal	Main stem (lg)	6.27	0.00	0.00	2.29	2.06	0.00
	Main stem (sm)	4.10	8.44	1.06	12.59	9.92	0.00
	Tributary (lg)	2.53	27.24	3.82	14.59	16.13	0.00
	Tributary (sm)	20.97	73.55	1.99	14.79	16.12	0.00
Wind	Main stem (lg)	0.87	0.00	0.00	0.00	10.72	8.73
	Main stem (sm)	0.00	2.89	0.00	0.00	11.13	8.97
	Tributary (lg)	1.30	1.63	1.86	0.00	5.60	8.48
	Tributary (sm)	0.39	0.77	1.70	0.00	18.89	16.49

[a] Main stem (lg) > 25 m; main stem (sm) 10–25 m; tributary (lg) 5–10 m; tributary (sm) < 5 m.

Table I.9 Accessible and inaccessible potential spawning kilometers for chum populations in the Lower Columbia ESU by stream width category.

Population	Stream Size[a]	Accessible	Inaccessible Due to Man-made Barriers	Inaccessible Due to Natural Barriers	Partially Accessible Due to Man-made Barriers	Partially Accessible Due to Natural Barriers	Unknown
Big Creek	Main stem (sm)	12.95	9.77	0.00	0.00	0.00	0.00
	Tributary (lg)	22.16	14.85	0.00	0.00	4.69	0.00
	Tributary (sm)	71.72	9.14	0.00	0.00	1.89	0.00
Clackamas	Main stem (lg)	36.96	0.00	0.00	0.00	0.00	0.00
	Main stem (sm)	0.03	0.00	0.00	0.00	0.00	0.00
	Tributary (lg)	43.75	0.00	0.00	0.00	1.31	0.00
	Tributary (sm)	325.27	55.17	0.00	0.00	8.49	0.00
Clatskanie	Main stem (sm)	56.51	0.00	13.22	0.00	0.00	0.00
	Tributary (lg)	71.84	0.12	43.43	1.71	0.00	3.33
	Tributary (sm)	111.12	0.00	53.03	0.67	0.00	2.46
Cowlitz	Main stem (lg)	120.58	3.61	0.00	0.00	0.00	0.00
	Main stem (sm)	131.41	6.56	1.94	0.00	4.67	0.00
	Tributary (lg)	210.73	62.55	17.79	0.00	18.84	0.00
	Tributary (sm)	371.77	87.42	19.37	1.47	28.44	2.18
Elochoman	Main stem (sm)	33.64	0.66	0.00	0.00	0.00	0.00
	Tributary (lg)	55.16	13.99	0.00	0.00	0.00	0.95
	Tributary (sm)	51.02	23.02	0.00	0.00	0.00	0.11
Grays	Main stem (sm)	45.84	0.00	0.00	0.00	0.00	0.00
	Tributary (lg)	74.00	0.00	6.80	0.00	0.00	0.00
	Tributary (sm)	109.11	0.70	14.15	0.00	0.00	0.00
Kalama	Main stem (sm)	61.28	0.00	4.99	0.00	0.00	0.00
	Tributary (lg)	25.96	1.67	16.52	0.00	0.00	0.25
	Tributary (sm)	26.22	4.83	12.53	0.12	0.00	0.20
Lewis	Main stem (lg)	30.39	38.90	0.00	0.00	3.67	0.00
	Main stem (sm)	75.56	42.62	3.14	0.00	5.26	0.00
	Tributary (lg)	88.43	36.63	7.04	5.65	20.98	0.00
	Tributary (sm)	124.66	79.31	7.59	4.46	22.81	1.04
Lower gorge tributaries	Main stem (lg)	0.00	0.00	0.00	0.00	0.00	0.00
	Main stem (sm)	14.17	0.23	0.00	0.00	0.00	4.90
	Tributary (lg)	12.75	0.00	0.31	1.62	0.00	0.99
	Tributary (sm)	51.13	0.45	0.51	1.67	0.00	0.96
Millcreek	Main stem (lg)	2.51	0.00	0.00	0.00	0.00	0.00
	Main stem (sm)	39.22	0.00	5.39	0.00	0.00	0.00
	Tributary (lg)	55.50	0.22	12.95	0.00	0.00	0.07
	Tributary (sm)	63.10	4.35	17.22	0.00	0.00	3.90
Salmon Creek	Main stem (lg)	0.00	0.86	0.00	0.00	10.78	0.00
	Main stem (sm)	10.22	10.09	0.00	21.79	15.98	0.00
	Tributary (lg)	19.13	1.47	1.04	27.98	17.66	0.00
	Tributary (sm)	77.21	30.23	0.41	72.87	45.82	0.58
Sandy	Main stem (lg)	50.33	2.01	0.00	17.63	0.00	0.00
	Main stem (sm)	8.56	17.38	0.00	0.00	0.00	5.68
	Tributary (lg)	16.80	4.42	2.23	1.21	0.00	14.86
	Tributary (sm)	38.28	22.61	2.46	15.15	0.00	10.34

Table 1.9 cont.

Population	Stream Size[a]	Accessible	Inaccessible Due to Man-made Barriers	Inaccessible Due to Natural Barriers	Partially Accessible Due to Man-made Barriers	Partially Accessible Due to Natural Barriers	Unknown
Scappoose	Main stem (lg)	37.17	0.00	0.00	0.00	0.00	0.00
	Main stem (sm)	29.19	0.00	0.00	0.00	24.86	0.00
	Tributary (lg)	57.64	10.26	14.77	0.00	9.45	0.00
	Tributary (sm)	173.84	30.05	15.01	9.81	27.47	0.65
Upper gorge tributaries	Main stem (lg)	8.95	8.48	0.00	0.00	2.79	0.00
	Main stem (sm)	4.79	2.60	21.70	0.00	0.37	2.01
	Tributary (lg)	1.37	0.85	5.89	0.00	0.00	0.27
	Tributary (sm)	36.37	10.61	22.16	0.00	0.05	0.00
Washougal	Main stem (lg)	18.10	0.00	0.00	8.38	6.56	0.00
	Main stem (sm)	7.88	27.75	1.37	11.90	13.90	0.00
	Tributary (lg)	4.17	31.91	2.91	9.04	10.14	0.00
	Tributary (sm)	16.73	55.97	0.54	9.90	8.10	0.00
Youngs	Main stem (sm)	45.78	13.47	20.08	0.00	1.64	0.00
	Tributary (lg)	67.58	0.60	19.88	0.00	0.29	5.68
	Tributary (sm)	153.89	3.50	13.69	0.00	0.28	6.46

[a] Main stem (lg) > 25 m; main stem (sm) 10–25 m; tributary (lg) 5–10 m; tributary (sm) < 5 m.

Table I.10 Accessible and inaccessible prime spawning kilometers for late fall chinook populations in the Lower Columbia ESU by stream width category.

Population	Stream Size[a]	Accessible	Inaccessible Due to Man-made Barriers	Inaccessible Due to Natural Barriers	Partially Accessible Due to Man-made Barriers	Partially Accessible Due to Natural Barriers	Unknown
East Fork Lewis	Main stem (sm)	8.94	0.00	1.07	0.00	0.72	0.00
	Tributary (lg)	16.43	2.56	1.24	2.06	2.44	0.00
	Tributary (sm)	19.10	15.56	0.62	1.25	2.78	0.31
North Fork Lewis	Main stem (lg)	0.86	0.33	0.00	0.00	0.00	0.00
	Main stem (sm)	3.98	7.63	0.00	0.00	0.00	0.00
	Tributary (lg)	8.00	7.74	0.39	0.00	0.56	0.00
	Tributary (sm)	12.19	6.05	1.11	0.00	2.87	0.00
Sandy	Main stem (lg)	13.10	0.00	0.00	10.17	0.00	0.00
	Main stem (sm)	11.57	0.00	0.25	0.00	0.00	1.92
	Tributary (lg)	7.96	0.00	0.00	1.84	0.00	3.46
	Tributary (sm)	15.18	3.66	0.00	8.66	0.00	3.60

[a] Mainstem (lg) > 25 m; mainstem (sm) 10–25 m; tributary (lg) 5–10 m; tributary (sm) < 5 m.

Table I.11 Accessible and inaccessible possible spawning kilometers for late fall chinook populations in the Lower Columbia ESU by stream width category.

Population	Stream Size[a]	Accessible	Inaccessible Due to Man-made Barriers	Inaccessible Due to Natural Barriers	Partially Accessible Due to Man-made Barriers	Partially Accessible Due to Natural Barriers	Unknown
East Fork Lewis	Main stem (sm)	23.96	0.00	3.36	0.00	2.85	0.00
	Tributary (lg)	46.37	7.33	4.90	5.05	11.22	0.00
	Tributary (sm)	63.49	47.60	3.07	4.91	10.12	0.93
North Fork Lewis	Main stem (lg)	2.53	2.42	0.00	0.00	0.00	0.00
	Main stem (sm)	10.84	28.54	0.00	0.00	0.00	0.00
	Tributary (lg)	22.67	24.32	1.81	0.00	3.58	0.00
	Tributary (sm)	37.42	23.88	6.04	0.00	9.45	0.00
Sandy	Main stem (lg)	37.81	0.00	0.00	21.85	0.00	0.00
	Main stem (sm)	52.20	0.00	2.65	0.15	0.00	7.85
	Tributary (lg)	26.64	0.00	0.49	3.48	0.00	17.67
	Tributary (sm)	52.87	7.98	0.22	22.21	0.00	14.35

[a] Main stem (lg) > 25 m; main stem (sm) 10–25 m; tributary (lg) 5–10 m; tributary (sm) < 5 m.

Table I.12 Accessible and inaccessible prime spawning kilometers for summer steelhead populations in the Lower Columbia ESU by stream width category.

Population	Stream Size[a]	Accessible	Inaccessible Due to Man-made Barriers	Inaccessible Due to Natural Barriers	Partially Accessible Due to Man-made Barriers	Partially Accessible Due to Natural Barriers	Unknown
East Fork Lewis	Main stem (sm)	1.33	0.00	1.69	0.00	1.79	0.00
	Tributary (lg)	8.52	1.81	1.00	0.90	4.24	0.00
	Tributary (sm)	15.89	11.82	1.27	1.55	1.77	0.27
Hood	Main stem (lg)	0.76	0.00	0.00	0.00	0.00	0.00
	Main stem (sm)	0.00	0.00	0.00	7.22	3.36	0.00
	Tributary (lg)	0.00	0.76	0.00	0.00	3.71	0.55
	Tributary (sm)	1.36	0.00	0.00	5.40	3.35	0.47
Kalama	Main stem (sm)	1.42	0.00	1.80	0.00	0.00	0.00
	Tributary (lg)	7.46	1.20	4.42	0.00	0.00	0.20
	Tributary (sm)	6.69	0.80	4.26	0.14	0.00	0.45
Lewis	Main stem (sm)	0.22	21.83	0.00	0.00	0.00	0.00
	Tributary (lg)	3.44	26.07	0.72	0.00	0.66	0.00
	Tributary (sm)	9.21	27.12	2.46	0.00	2.71	0.00
Washougal	Main stem (lg)	0.00	0.00	0.00	0.21	0.44	0.00
	Main stem (sm)	0.44	0.00	0.33	1.66	0.83	0.00
	Tributary (lg)	0.48	3.18	0.46	2.97	2.97	0.00
	Tributary (sm)	4.10	13.10	0.53	2.78	3.28	0.00
Wind	Main stem (lg)	0.24	0.00	0.00	0.00	0.91	0.00
	Main stem (sm)	0.00	0.37	0.00	0.00	0.59	0.25
	Tributary (lg)	0.00	0.30	0.18	0.00	1.44	2.16
	Tributary (sm)	0.00	0.08	0.36	0.00	4.20	3.15

[a] Main stem (lg) > 25 m; main stem (sm) 10–25 m; tributary (lg) 5–10 m; tributary (sm) < 5 m.

Table I.13 Accessible and inaccessible possible spawning kilometers for summer steelhead populations in the Lower Columbia ESU by stream width category.

Population	**Stream Size**[a]	**Accessible**	**Inaccessible Due to Man-made Barriers**	**Inaccessible Due to Natural Barriers**	**Partially Accessible Due to Man-made Barriers**	**Partially Accessible Due to Natural Barriers**	**Unknown**
East Fork Lewis	Main stem (sm)	23.96	0.00	3.36	0.00	9.47	0.00
	Tributary (lg)	46.37	7.33	4.90	6.15	16.09	0.00
	Tributary (sm)	63.49	47.60	3.07	4.91	10.31	0.93
Hood	Main stem (lg)	10.77	0.00	0.00	1.99	0.00	0.00
	Main stem (sm)	0.00	0.00	0.00	14.14	35.62	0.00
	Tributary (lg)	0.00	2.33	0.00	0.00	6.18	1.39
	Tributary (sm)	8.04	0.27	0.00	13.65	6.77	0.90
Kalama	Main stem (sm)	30.39	0.00	6.04	0.00	0.00	0.00
	Tributary (lg)	26.26	2.34	11.58	0.00	0.00	0.39
	Tributary (sm)	20.91	2.76	11.00	0.18	0.00	0.45
Lewis	Main stem (lg)	2.53	2.80	0.00	0.00	0.00	0.00
	Main stem (sm)	10.84	121.30	0.00	0.00	0.00	0.00
	Tributary (lg)	22.67	77.42	1.81	0.00	3.58	0.00
	Tributary (sm)	37.42	76.42	6.04	0.00	9.45	0.00
Washougal	Main stem (lg)	5.78	0.00	0.00	2.17	2.06	0.00
	Main stem (sm)	3.81	8.05	0.97	9.46	8.98	0.00
	Tributary (lg)	2.28	22.00	2.38	8.98	10.94	0.00
	Tributary (sm)	11.90	49.70	1.00	9.25	8.46	0.00
Wind	Main stem (lg)	0.87	0.00	0.00	0.00	9.35	8.73
	Main stem (sm)	0.00	2.89	0.00	0.00	9.22	8.67
	Tributary (lg)	1.02	1.13	1.86	0.00	3.56	5.46
	Tributary (sm)	0.29	0.25	0.94	0.00	12.07	10.84

[a] Main stem (lg) > 25 m; main stem (sm) 10–25 m; tributary (lg) 5–10 m; tributary (sm) < 5 m.

Table I.14 Accessible and inaccessible prime spawning kilometers for spring chinook populations in the Lower Columbia ESU by stream width category.

Population	**Stream Size**[a]	**Accessible**	**Inaccessible Due to Man-made Barriers**	**Inaccessible Due to Natural Barriers**	**Partially Accessible Due to Man-made Barriers**	**Partially Accessible Due to Natural Barriers**	**Unknown**
Big White Salmon	Main stem (lg)	0.00	10.76	0.00	0.00	0.00	0.00
	Main stem (sm)	0.00	13.52	0.00	0.00	0.00	0.00
	Tributary (lg)	0.00	12.70	0.00	0.00	0.00	0.00
	Tributary (sm)	0.00	41.91	0.00	0.00	0.00	0.00
Cispus	Main stem (lg)	0.00	2.13	0.00	0.00	0.00	0.00
	Main stem (sm)	0.00	22.70	17.19	0.00	0.00	0.00
	Tributary (lg)	0.00	0.94	15.74	0.00	0.00	0.00
	Tributary (sm)	0.00	2.99	14.49	0.00	0.00	0.00
Hood	Main stem (lg)	5.38	0.00	0.00	4.37	0.00	0.00
	Main stem (sm)	0.00	0.00	0.00	7.95	16.47	0.00
	Tributary (lg)	0.00	0.00	0.00	0.00	0.57	0.00
	Tributary (sm)	3.05	0.53	0.00	12.80	0.99	0.16
Kalama	Main stem (sm)	11.77	0.00	2.28	0.00	0.00	0.00
	Tributary (lg)	7.44	0.20	2.51	0.00	0.00	0.00
	Tributary (sm)	5.06	0.39	3.13	0.04	0.00	0.00
Lewis	Main stem (lg)	0.86	0.55	0.00	0.00	0.00	0.00
	Main stem (sm)	3.98	39.23	0.00	0.00	0.00	0.00
	Tributary (lg)	8.00	20.50	0.39	0.00	0.56	0.00
	Tributary (sm)	12.29	19.82	1.11	0.00	2.87	0.00
Sandy	Main stem (lg)	16.28	0.13	0.00	10.17	0.00	0.00
	Main stem (sm)	10.57	7.67	0.25	0.00	0.00	1.92
	Tributary (lg)	4.58	1.90	0.90	1.84	0.00	1.58
	Tributary (sm)	4.89	5.90	0.70	7.28	0.00	2.68
Tilton	Main stem (sm)	0.00	8.61	0.00	0.00	0.00	0.00
	Tributary (lg)	0.00	9.01	0.08	0.00	0.00	0.00
	Tributary (sm)	0.00	13.53	0.00	0.00	0.00	0.00
Toutle	Main stem (lg)	8.97	0.00	0.00	0.00	0.00	0.00
	Main stem (sm)	18.54	9.18	1.11	0.36	1.23	0.63
	Tributary (lg)	12.44	7.21	7.14	1.99	0.04	1.89
	Tributary (sm)	21.27	14.47	6.67	6.59	0.05	1.07
Upper Cowlitz	Main stem (sm)	0.00	22.06	4.06	0.00	1.37	0.00
	Tributary (lg)	0.00	20.67	11.52	0.00	0.00	0.00
	Tributary (sm)	0.00	41.41	12.02	0.00	0.00	0.00

[a] Main stem (lg) > 25 m; main stem (sm) 10–25 m; tributary (lg) 5–10 m; tributary (sm) < 5 m.

Table I.15 Accessible and inaccessible possible spawning kilometers for spring chinook populations in the Lower Columbia ESU by stream width category.

Population	Stream Size[a]	Accessible	Inaccessible Due to Man-made Barriers	Inaccessible Due to Natural Barriers	Partially Accessible Due to Man-made Barriers	Partially Accessible Due to Natural Barriers	Unknown
Big White Salmon	Main stem (lg)	0.33	26.09	0.00	0.00	0.00	0.00
	Main stem (sm)	0.00	35.82	0.00	0.00	0.00	0.00
	Tributary (lg)	0.00	26.62	0.00	0.00	0.00	0.00
	Tributary (sm)	0.00	142.99	0.00	0.00	0.00	0.00
Cispus	Main stem (lg)	0.00	9.03	0.00	0.00	0.00	0.00
	Main stem (sm)	0.00	47.83	58.60	0.00	0.00	0.00
	Tributary (lg)	0.00	4.74	63.72	0.00	0.00	0.00
	Tributary (sm)	0.00	14.09	58.22	0.00	0.00	0.00
Hood	Main stem (lg)	10.77	0.00	0.00	5.58	0.00	0.00
	Main stem (sm)	0.00	0.00	0.00	18.70	35.62	0.00
	Tributary (lg)	0.00	0.00	0.00	0.00	6.18	1.39
	Tributary (sm)	8.04	0.89	0.00	57.90	6.77	1.36
Kalama	Main stem (sm)	30.39	0.00	6.04	0.00	0.00	0.00
	Tributary (lg)	26.26	2.34	11.58	0.00	0.00	0.39
	Tributary (sm)	20.91	2.76	11.00	0.18	0.00	0.45
Lewis	Main stem (lg)	2.53	2.80	0.00	0.00	0.00	0.00
	Main stem (sm)	10.84	121.30	0.00	0.00	0.00	0.00
	Tributary (lg)	22.67	77.42	1.81	0.00	3.58	0.00
	Tributary (sm)	37.58	76.42	6.04	0.00	9.45	0.00
Sandy	Main stem (lg)	37.13	0.29	0.00	21.85	0.00	0.00
	Main stem (sm)	48.51	23.07	2.65	0.15	0.00	7.85
	Tributary (lg)	17.00	9.06	2.87	3.48	0.00	11.63
	Tributary (sm)	21.55	18.66	2.85	17.05	0.00	11.48
Tilton	Main stem (sm)	0.00	24.98	0.00	0.00	0.00	0.00
	Tributary (lg)	0.00	27.61	1.10	0.00	0.00	0.00
	Tributary (sm)	0.00	40.02	0.26	0.00	0.00	0.00
Toutle	Main stem (lg)	20.78	0.00	0.00	0.00	0.00	0.00
	Main stem (sm)	49.66	23.26	4.15	0.81	2.22	1.98
	Tributary (lg)	38.01	23.72	26.15	6.35	0.98	6.12
	Tributary (sm)	75.16	49.15	27.72	22.73	0.26	4.92
Upper Cowlitz	Main stem (lg)	0.00	3.04	0.00	0.00	0.00	0.00
	Main stem (sm)	0.00	69.17	34.99	0.00	3.68	0.00
	Tributary (lg)	0.00	66.99	45.47	0.00	0.00	0.00
	Tributary (sm)	0.00	132.93	42.91	0.00	0.00	0.00

[a] Main stem (lg) > 25 m; main stem (sm) 10–25 m; tributary (lg) 5–10 m; tributary (sm) < 5 m.

Table I.16 Accessible and inaccessible prime spawning kilometers for spring chinook populations in the Willamette ESU by stream width category.

Population	Stream Size[a]	Accessible	Inaccessible Due to Man-made Barriers	Inaccessible Due to Natural Barriers	Partially Accessible Due to Man-made Barriers	Partially Accessible Due to Natural Barriers	Unknown
Calapooia	Main stem (lg)	0.71	0.00	0.00	0.00	0.00	0.00
	Main stem (sm)	12.92	0.91	0.00	0.00	0.00	0.00
	Tributary (lg)	8.45	9.03	0.06	5.02	0.00	0.00
	Tributary (sm)	14.33	17.48	0.00	11.61	0.00	0.00
Clackamas	Main stem (lg)	33.71	8.30	0.00	0.00	0.29	0.00
	Main stem (sm)	13.73	4.20	7.19	0.00	10.24	0.45
	Tributary (lg)	5.80	7.29	6.03	0.00	7.91	3.89
	Tributary (sm)	26.75	14.28	6.66	1.77	13.45	5.09
McKenzie	Main stem (lg)	0.49	0.00	0.00	1.84	0.00	0.00
	Main stem (sm)	10.73	7.19	6.68	15.54	0.00	5.36
	Tributary (lg)	12.14	9.45	19.99	6.79	0.74	1.84
	Tributary (sm)	20.07	10.70	22.06	15.69	0.00	2.82
Middle Fork Willamette	Main stem (lg)	0.77	9.22	0.00	0.00	0.00	0.00
	Main stem (sm)	9.15	29.30	1.03	6.55	9.98	1.95
	Tributary (lg)	2.02	14.92	0.76	3.15	7.23	1.00
	Tributary (sm)	8.30	25.39	0.41	9.10	1.63	1.15
Molalla	Main stem (sm)	51.94	0.00	2.79	2.79	13.79	0.00
	Tributary (lg)	17.00	21.88	5.03	3.43	2.04	0.50
	Tributary (sm)	49.81	62.14	3.44	6.77	2.19	2.51
North Santiam	Main stem (sm)	0.62	6.93	6.19	5.56	0.50	0.00
	Tributary (lg)	2.41	8.78	5.43	8.13	1.67	0.00
	Tributary (sm)	10.51	11.30	2.59	18.81	0.13	0.04
South Santiam	Main stem (lg)	0.37	0.00	0.00	0.00	0.00	0.00
	Main stem (sm)	19.91	6.69	2.15	3.74	6.77	2.35
	Tributary (lg)	22.73	7.99	11.67	2.40	7.59	1.60
	Tributary (sm)	65.97	46.66	1.46	15.78	1.45	1.67

[a] Main stem (lg) > 25 m; main stem (sm) 10–25 m; tributary (lg) 5–10 m; tributary (sm) < 5 m.

Table I.17 Accessible and inaccessible possible spawning kilometers for spring chinook populations in the Willamette ESU by stream width category.

Population	Stream Size[a]	Accessible	Inaccessible Due to Man-made Barriers	Inaccessible Due to Natural Barriers	Partially Accessible Due to Man-made Barriers	Partially Accessible Due to Natural Barriers	Unknown
Calapooia	Main stem (lg)	4.12	0.00	0.00	0.00	0.00	0.00
	Main stem (sm)	28.13	3.19	0.00	0.47	0.00	0.00
	Tributary (lg)	26.07	24.25	0.34	13.31	0.00	0.00
	Tributary (sm)	54.37	61.67	0.18	36.98	0.00	0.00
Clackamas	Main stem (lg)	88.91	16.62	0.00	0.00	1.40	0.65
	Main stem (sm)	42.58	15.17	23.77	0.00	30.26	2.23
	Tributary (lg)	18.37	19.71	23.34	0.00	29.57	10.26
	Tributary (sm)	94.90	54.36	26.46	9.01	54.45	21.57
McKenzie	Main stem (lg)	4.11	0.00	0.00	5.88	0.00	0.00
	Main stem (sm)	24.78	34.61	29.39	55.93	0.00	11.94
	Tributary (lg)	45.15	27.58	65.41	21.27	4.85	7.70
	Tributary (sm)	72.00	36.83	85.33	49.28	0.13	10.60
Middle Fork Willamette	Main stem (lg)	4.91	20.57	0.00	0.00	0.00	0.00
	Main stem (sm)	22.49	83.17	5.04	27.26	25.79	10.00
	Tributary (lg)	11.53	47.15	3.87	8.61	24.76	3.13
	Tributary (sm)	32.09	77.67	1.98	28.73	10.44	3.52
Molalla	Main stem (lg)	1.29	0.00	0.00	0.00	0.00	0.00
	Main stem (sm)	125.07	0.26	9.45	3.31	32.41	0.00
	Tributary (lg)	67.82	73.74	29.58	7.23	14.60	2.55
	Tributary (sm)	151.08	182.14	14.88	22.57	6.75	8.12
North Santiam	Main stem (lg)	0.17	0.00	0.00	0.00	0.00	0.00
	Main stem (sm)	3.35	27.13	22.31	24.83	2.55	0.00
	Tributary (lg)	11.80	27.97	20.45	23.02	6.95	0.28
	Tributary (sm)	37.48	41.14	14.08	61.41	1.00	0.24
South Santiam	Main stem (lg)	2.81	0.00	0.00	0.00	0.00	0.00
	Main stem (sm)	57.39	24.42	8.98	6.76	20.66	6.60
	Tributary (lg)	61.13	34.80	37.31	7.03	27.09	13.79
	Tributary (sm)	212.11	153.29	10.12	44.08	6.22	5.49

[a] Main stem (lg) > 25 m; main stem (sm) 10–25 m; tributary (lg) 5–10 m; tributary (sm) < 5 m.

Table I.18 Accessible and inaccessible prime spawning kilometers for winter steelhead populations in the Willamette ESU by stream width category.

Population	Stream Size[a]	Accessible	Inaccessible Due to Man-made Barriers	Inaccessible Due to Natural Barriers	Partially Accessible Due to Man-made Barriers	Partially Accessible Due to Natural Barriers	Unknown
Calapooia	Main stem (lg)	0.71	0.00	0.00	0.00	0.00	0.00
	Main stem (sm)	17.98	0.91	0.00	0.00	0.00	0.00
	Tributary (lg)	19.67	21.03	0.40	11.02	0.00	0.00
	Tributary (sm)	52.32	57.55	0.18	37.05	0.00	0.00
Coast Range	Main stem (lg)	0.38	0.00	0.00	0.09	0.00	0.00
	Main stem (sm)	11.96	4.27	11.19	15.95	5.24	3.08
	Tributary (lg)	45.28	71.92	26.49	132.90	13.85	12.62
	Tributary (sm)	236.02	408.45	30.66	474.95	14.09	35.95
Molalla	Main stem (sm)	76.06	0.00	11.07	3.09	30.96	0.00
	Tributary (lg)	53.55	37.05	37.47	4.49	25.59	2.39
	Tributary (sm)	131.77	152.46	19.95	23.54	9.68	8.43
North Santiam	Main stem (sm)	1.51	20.13	20.58	10.70	2.37	0.00
	Tributary (lg)	7.19	30.00	24.49	20.19	6.88	0.37
	Tributary (sm)	23.47	48.27	19.25	55.58	1.54	0.29
South Santiam	Main stem (lg)	0.37	0.00	0.00	0.00	0.00	0.00
	Main stem (sm)	28.68	18.71	6.77	3.74	19.73	6.56
	Tributary (lg)	41.83	28.88	45.58	7.79	31.32	19.13
	Tributary (sm)	194.84	135.88	14.14	49.18	8.36	7.57

[a] Main stem (lg) > 25 m; main stem (sm) 10–25 m; tributary (lg) 5–10 m; tributary (sm) < 5 m.

Table I.19 Accessible and inaccessible possible spawning kilometers for winter steelhead populations in the Willamette ESU by stream width category.

Population	Stream Size[a]	Accessible	Inaccessible Due to Man-made Barriers	Inaccessible Due to Natural Barriers	Partially Accessible Due to Man-made Barriers	Partially Accessible Due to Natural Barriers	Unknown
Calapooia	Main stem (lg)	4.12	0.00	0.00	0.00	0.00	0.00
	Main stem (sm)	29.29	3.19	0.00	0.47	0.00	0.00
	Tributary (lg)	29.77	26.96	0.51	14.16	0.00	0.00
	Tributary (sm)	75.39	84.57	0.43	50.14	0.00	0.00
Coast Range	Main stem (lg)	2.27	0.00	0.00	3.80	0.00	0.00
	Main stem (sm)	41.71	4.89	13.97	46.54	9.03	8.31
	Tributary (lg)	76.67	117.93	34.38	191.89	15.56	20.12
	Tributary (sm)	321.55	554.15	41.17	650.07	17.25	52.88
Molalla	Main stem (lg)	1.29	0.00	0.00	0.00	0.00	0.00
	Main stem (sm)	130.57	0.26	11.27	3.31	35.41	0.00
	Tributary (lg)	80.47	79.27	52.46	7.55	35.82	4.93
	Tributary (sm)	185.49	223.68	28.66	31.07	13.06	9.81
North Santiam	Main stem (lg)	0.17	0.00	0.00	0.00	0.00	0.00
	Main stem (sm)	3.72	30.28	27.92	25.72	4.01	0.00
	Tributary (lg)	13.42	44.15	34.05	28.22	8.95	0.37
	Tributary (sm)	42.67	62.32	27.50	80.90	2.43	0.51
South Santiam	Main stem (lg)	2.81	0.00	0.00	0.00	0.00	0.00
	Main stem (sm)	61.51	27.72	11.26	6.76	23.96	6.60
	Tributary (lg)	66.90	49.43	63.19	12.23	41.52	25.19
	Tributary (sm)	282.58	198.83	19.36	68.98	13.25	10.96

[a] Main stem (lg) > 25 m; main stem (sm) 10–25 m; tributary (lg) 5–10 m; tributary (sm) < 5 m.

Table I.20 A comparison of accessible and inaccessible prime spawning kilometers for multiple species of concern in the Kalama and Clackamas watersheds.

Population	Stream Size[a]	Accessible	Inaccessible Due to Man-made Barriers	Inaccessible Due to Natural Barriers	Partially Accessible Due to Man-made Barriers	Partially Accessible Due to Natural Barriers	Unknown
KALAMA							
Fall chinook	Main stem (sm)	30.39	0.00	6.04	0.00	0.00	0.00
	Tributary (lg)	26.26	2.34	11.58	0.00	0.00	0.39
	Tributary (sm)	20.91	2.76	11.00	0.18	0.00	0.45
Winter steelhead	Main stem (sm)	33.53	0.00	8.59	0.00	0.00	0.00
	Tributary (lg)	41.79	4.76	17.44	0.08	0.00	0.97
	Tributary (sm)	36.25	5.37	21.33	0.58	0.00	0.67
Chum	Main stem (sm)	61.28	0.00	4.99	0.00	0.00	0.00
	Tributary (lg)	25.96	1.67	16.52	0.00	0.00	0.25
	Tributary (sm)	26.22	4.83	12.53	0.12	0.00	0.20
Summer steelhead	Main stem (sm)	30.39	0.00	6.04	0.00	0.00	0.00
	Tributary (lg)	26.26	2.34	11.58	0.00	0.00	0.39
	Tributary (sm)	20.91	2.76	11.00	0.18	0.00	0.45
Spring chinook	Main stem (sm)	30.39	0.00	6.04	0.00	0.00	0.00
	Tributary (lg)	26.26	2.34	11.58	0.00	0.00	0.39
	Tributary (sm)	20.91	2.76	11.00	0.18	0.00	0.45
CLACKAMAS							
Fall chinook	Main stem (lg)	18.56	0.00	0.00	0.00	0.00	0.20
	Main stem (sm)	48.87	0.00	7.97	0.00	10.34	0.00
	Tributary (lg)	44.22	0.00	14.15	0.15	16.18	0.60
	Tributary (sm)	379.73	45.28	17.55	24.06	25.83	4.83
Winter steelhead	Main stem (lg)	92.79	17.07	0.00	0.00	1.89	0.65
	Main stem (sm)	87.13	18.84	40.22	2.69	33.88	3.07
	Tributary (lg)	68.86	24.47	54.24	9.11	40.42	14.69
	Tributary (sm)	428.48	146.86	58.24	59.89	94.13	38.92
Chum	Main stem (lg)	36.96	0.00	0.00	0.00	0.00	0.00
	Main stem (sm)	0.03	0.00	0.00	0.00	0.00	0.00
	Tributary (lg)	43.75	0.00	0.00	0.00	1.31	0.00
	Tributary (sm)	325.27	55.17	0.00	0.00	8.49	0.00
Spring chinook	Main stem (lg)	88.91	16.62	0.00	0.00	1.40	0.65
	Main stem (sm)	42.58	15.17	23.77	0.00	30.26	2.23
	Tributary (lg)	18.37	19.71	23.34	0.00	29.57	10.26
	Tributary (sm)	94.90	54.36	26.46	9.01	54.45	21.57

[a] Main stem (lg) > 25 m; main stem (sm) 10–25 m; tributary (lg) 5–10 m; tributary (sm) < 5 m.

Table I.21 Currently and historically available prime and possible spawning kilometers for those populations with estimated viability targets. Estimated population viability targets for each of four scenarios are provided in the final columns.

ESU	Population[a]	Possible Current	Possible Historical	Prime Current	Prime Historical	Current Abundance	Scenario 1[b] (5%)	Scenario 1[b] (15%)	Scenario 2[c] (5%)	Scenario 3[d] (5%)	Scenario 4[e](5%)
Columbia chum	Grays (winter)	228.95	229.65			960	3,300	2,000	6,300	3,900	7,100
	Lower gorge (winter)	81.33	82.02			375	1,600	1,000	3,000	1,900	3,500
Upper Willamette steelhead	North Santiam (winter)	210.23	346.97	129.43	227.82	1,382	4,500	2,600	8,700	5,200	9,900
	South Santiam (winter)	580.51	856.49	385.86	569.33	916	3,300	1,900	6,000	3,800	7,100
	Mollala (winter)	524.04	827.25	358.74	548.24	655	2,400	1,500	4,700	2,900	5,500
	Calapooia (winter)	203.33	318.06	138.75	218.25	104	700	400	1,100	700	1,300
Upper Willamette chinook	McKenzie (spring)	283.38	382.41	84.03	111.38	1,861	5,700	3,300	10,700	6,600	13,000
	Clackamas (spring)	369.47	475.33	113.64	147.71	1,103	3,600	2,200	7,000	4,300	8,300
Lower Columbia steelhead	Wind (winter)	48.9	54.18	37.83	42.49	286	1,300	800	2,400	1,500	2,900
	South Fork Toutle (summer)	81.57	92.12	60.25	68.1	463	1,900	1,100	3,600	2,200	4,100
	Sandy (winter)	295.09	386.1	215.42	281.81	965	3,300	2,000	6,400	3,800	7,400
	North Fork Toutle (winter)	209.43	330.13	143.12	229.88	176	900	600	1,700	1,100	1,900
	Kalama (winter)	112.23	122.36	78.76	84.78	539	2,200	1,300	4,000	2,300	4,600
	Kalama (summer)	77.74	82.84	15.71	17.71	443	1,800	1,100	3,400	2,100	4,000
	Hood (winter)	137.58	138.47	117.71	118.6	593	2,300	1,400	4,400	2,700	5,000
	Hood (summer)	97.16	99.77	25.16	25.93	560	2,100	1,300	4,200	2,500	4,800
	Clackamas (winter)	919.27	1126.52	649.23	815.49	386	1,600	1,000	3,100	1,900	3,500
Lower Columbia chinook	White Salmon (fall)	0.33	70.94	0	23.07	163	900	600	1,600	1,000	1,800
	Washougal (fall)	84.05	163.8	24.91	49.66	735	2,700	1,600	5,200	3,000	5,800
	Sandy (late fall)	217.21	225.19	68.48	72.14	1,095	3,600	2,200	7,000	4,300	8,400
	North Fork Lewis (bright)	86.66	364.61	28.56	108.65	8,915	20,300	12,000	39,300	23,800	47,900
	Mill, Abernathy, Germ. (fall)	117.45	122.79	37.15	38.59	348	1,500	1,000	2,900	1,700	3,300
	Kalama (fall)	77.74	82.84	24.31	24.9	1,192	3,900	2,400	7,600	4,400	8,700
	Grays (fall)	132.52	132.52	45.26	45.26	62	500	300	800	500	900
	Elochoman	85.36	115.57	27.76	36.23	297	1,400	800	2,500	1,500	2,800
	Cowlitz (fall)	418.05	918.86	137.54	290.61	748	2,800	1,600	5,300	3,200	6,100
	Coweeman (fall)	61.28	71.09	19.49	22.02	425	1,800	1,100	3,400	2,000	3,800

Clackamas (fall)	567.95	613.22	186.45	201.4	164	900	600	1,600	1,000	1,800
Sandy (fall)	227.1	285.77	72.67	91.8	140	800	500	1,400	900	1,700

[a] Populations and scenarios are from Appendix D (Tables D.3–D.6).

[b] The two targets for scenario 1 represent a 5 and a 15% chance of extinction in the next 100 years. Scenario 1 assumes no hatchery influence and no change in marine survival.

[c] Scenario 2 assumes some hatchery influence and no change in marine survival.

[d] Scenario 3 assumes no hatchery influence and a change in marine survival.

[e] Scenario 4 assumes both a hatchery influence and a change in marine survival.

Table I.22 Implied fish densities for current fish abundance and for scenarios of a 5% and a 15% risk of extinction in 100 years.

ESU		Current Abundance				Scenario 1[b]–5% Extinction Risk				Scenario 1–15% Extinction Risk			
		Possible		Prime		Possible		Prime		Possible		Prime	
	Population[a]	Current	Historical	Current	Historical	Current	Historical	Current	Historical	Current	Historical	Current	Historical
Lower Columbia River chum	Grays	4.2	4.2			14.4	14.4			8.7	8.7		
	Lower gorge	4.6	4.6			19.7	19.5			12.3	12.2		
Upper Willamette River steelhead	North Santiam	6.6	4.0	10.7	6.1	21.4	13.0	34.8	19.8	12.4	7.5	20.1	11.4
	South Santiam	1.6	1.1	2.4	1.6	5.7	3.9	8.6	5.8	3.3	2.2	4.9	3.3
	Mollala	1.2	0.8	1.8	1.2	4.6	2.9	6.7	4.4	2.9	1.8	4.2	2.7
	Calapooia	0.5	0.3	0.7	0.5	3.4	2.2	5.0	3.2	2.0	1.3	2.9	1.8
Upper Willamette River chinook	McKenzie	6.6	4.9	22.1	16.7	20.1	14.9	67.8	51.2	11.6	8.6	39.3	29.6
	Clackamas	3.0	2.3	9.7	7.5	9.7	7.6	31.7	24.4	6.0	4.6	19.4	14.9
Lower Columbia River steelhead	Wind	5.8	5.3	7.6	6.7	26.6	24.0	34.4	30.6	16.4	14.8	21.1	18.8
	South Fork Toutle	5.7	5.0	7.7	6.8	23.3	20.6	31.5	27.9	13.5	11.9	18.3	16.2
	Sandy	3.3	2.5	4.5	3.4	11.2	8.5	15.3	11.7	6.8	5.2	9.3	7.1
	North Fork Toutle	0.8	0.5	1.2	0.8	4.3	2.7	6.3	3.9	2.9	1.8	4.2	2.6
	Kalama (winter)	4.8	4.4	6.8	6.4	19.6	18.0	27.9	25.9	11.6	10.6	16.5	15.3
	Kalama (summer)	5.7	5.3	28.2	25.0	23.2	21.7	114.6	101.6	14.1	13.3	70.0	62.1
	Hood (winter)	4.3	4.3	5.0	5.0	16.7	16.6	19.5	19.4	10.2	10.1	11.9	11.8
	Hood (summer)	5.8	5.6	22.3	21.6	21.6	21.0	83.5	81.0	13.4	13.0	51.7	50.1
	Clackamas	0.4	0.3	0.6	0.5	1.7	1.4	2.5	2.0	1.1	0.9	1.5	1.2
Lower Columbia River chinook	White Salmon	493.9	2.3		7.1	2727.3	12.7		39.0	1818.2	8.5		26.0
	Washougal	8.7	4.5	29.5	14.8	32.1	16.5	108.4	54.4	19.0	9.8	64.2	32.2
	Sandy (late fall)	5.0	4.9	16.0	15.2	16.6	16.0	52.6	49.9	10.1	9.8	32.1	30.5
	North Fork Lewis	102.9	24.5	312.1	82.1	234.2	55.7	710.8	186.8	138.5	32.9	420.2	110.4
	Mill	3.0	2.8	9.4	9.0	12.8	12.2	40.4	38.9	8.5	8.1	26.9	25.9
	Kalama	15.3	14.4	49.0	47.9	50.2	47.1	160.4	156.6	30.9	29.0	98.7	96.4
	Grays	0.5	0.5	1.4	1.4	3.8	3.8	11.0	11.0	2.3	2.3	6.6	6.6
	Elochoman	3.5	2.6	10.7	8.2	16.4	12.1	50.4	38.6	9.4	6.9	28.8	22.1
	Cowlitz	1.8	0.8	5.4	2.6	6.7	3.0	20.4	9.6	3.8	1.7	11.6	5.5
	Coweeman	6.9	6.0	21.8	19.3	29.4	25.3	92.4	81.7	18.0	15.5	56.4	50.0
	Clackamas fall	0.3	0.3	0.9	0.8	1.6	1.5	4.8	4.5	1.1	1.0	3.2	3.0
	Sandy	0.6	0.5	1.9	1.5	3.5	2.8	11.0	8.7	2.2	1.7	6.9	5.4

[a] Populations and scenarios are from Appendix D (Tables D.3–D.6).

[b] Scenario 1 assumes no hatchery influence and no change in marine survival.

Table I.23 Implied fish densities for scenarios 2, 3, and 4 with a 5% extinction risk in the next 100 years.

ESU	Population[a]	Scenario [b]2–5% Extinction Risk				Scenario 3[c]–5% Extinction Risk				Scenario 4[d]–5% Extinction Risk			
		Possible		Prime		Possible		Prime		Possible		Prime	
		Current	Historical	Current	Historical	Current	Historical	Current	Historical	Current	Historical	Current	Historical
Lower Columbia River chum	Grays	27.5	27.4			17.0	17.0			31.0	30.9		
	Lower gorge	36.9	36.6			23.4	23.2			43.0	42.7		
Upper Willamette River steelhead	North Santiam	41.4	25.1	67.2	38.2	24.7	15.0	40.2	22.8	47.1	28.5	76.5	43.5
	South Santiam	10.3	7.0	15.5	10.5	6.5	4.4	9.8	6.7	12.2	8.3	18.4	12.5
	Mollala	9.0	5.7	13.1	8.6	5.5	3.5	8.1	5.3	10.5	6.6	15.3	10.0
	Calapooia	5.4	3.5	7.9	5.0	3.4	2.2	5.0	3.2	6.4	4.1	9.4	6.0
Upper Willamette Chinook	McKenzie	37.8	28.0	127.3	96.1	23.3	17.3	78.5	59.3	45.9	34.0	154.7	116.7
	Clackamas	18.9	14.7	61.6	47.4	11.6	9.0	37.8	29.1	22.5	17.5	73.0	56.2
Lower Columbia River steelhead	Wind	49.1	44.3	63.4	56.5	30.7	27.7	39.7	35.3	59.3	53.5	76.7	68.3
	South Fork Toutle	44.1	39.1	59.8	52.9	27.0	23.9	36.5	32.3	50.3	44.5	68.0	60.2
	Sandy	21.7	16.6	29.7	22.7	12.9	9.8	17.6	13.5	25.1	19.2	34.4	26.3
	North Fork Toutle	8.1	5.1	11.9	7.4	5.3	3.3	7.7	4.8	9.1	5.8	13.3	8.3
	Kalama (winter)	35.6	32.7	50.8	47.2	20.5	18.8	29.2	27.1	41.0	37.6	58.4	54.3
	Kalama (summer)	43.7	41.0	216.4	192.0	27.0	25.4	133.7	118.6	51.5	48.3	254.6	225.9
	Hood (winter)	32.0	31.8	37.4	37.1	19.6	19.5	22.9	22.8	36.3	36.1	42.5	42.2
	Hood (summer)	43.2	42.1	166.9	162.0	25.7	25.1	99.4	96.4	49.4	48.1	190.8	185.1
	Clackamas	3.4	2.8	4.8	3.8	2.1	1.7	2.9	2.3	3.8	3.1	5.4	4.3
Lower Columbia River chinook	White Salmon	4848.5	22.6		69.4	3030.3	14.1		43.3	5454.5	25.4		78.0
	Washougal	61.9	31.7	208.8	104.7	35.7	18.3	120.4	60.4	69.0	35.4	232.8	116.8
	Sandy (late fall)	32.2	31.1	102.2	97.0	19.8	19.1	62.8	59.6	38.7	37.3	122.7	116.4
	North Fork Lewis	453.5	107.8	1376.1	361.7	274.6	65.3	833.3	219.1	552.7	131.4	1677.2	440.9
	Mill	24.7	23.6	78.1	75.1	14.5	13.8	45.8	44.1	28.1	26.9	88.8	85.5
	Kalama	97.8	91.7	312.6	305.2	56.6	53.1	181.0	176.7	111.9	105.0	357.9	349.4
	Grays	6.0	6.0	17.7	17.7	3.8	3.8	11.0	11.0	6.8	6.8	19.9	19.9
	Elochoman	29.3	21.6	90.1	69.0	17.6	13.0	54.0	41.4	32.8	24.2	100.9	77.3
	Cowlitz	12.7	5.8	38.5	18.2	7.7	3.5	23.3	11.0	14.6	6.6	44.4	21.0
	Coweeman	55.5	47.8	174.4	154.4	32.6	28.1	102.6	90.8	62.0	53.5	195.0	172.6
	Clackamas (fall)	2.8	2.6	8.6	7.9	1.8	1.6	5.4	5.0	3.2	2.9	9.7	8.9
	Sandy	6.2	4.9	19.3	15.3	4.0	3.1	12.4	9.8	7.5	5.9	23.4	18.5

[a] Populations and scenarios are from Appendix D (Tables D.3–D.6).

[b] Scenario 2 assumes some hatchery influence and no change in marine survival.

[c] Scenario 3 assumes no hatchery influence and a change in marine survival.

[d] Scenario 4 assumes both a hatchery influence and a change in marine survival.

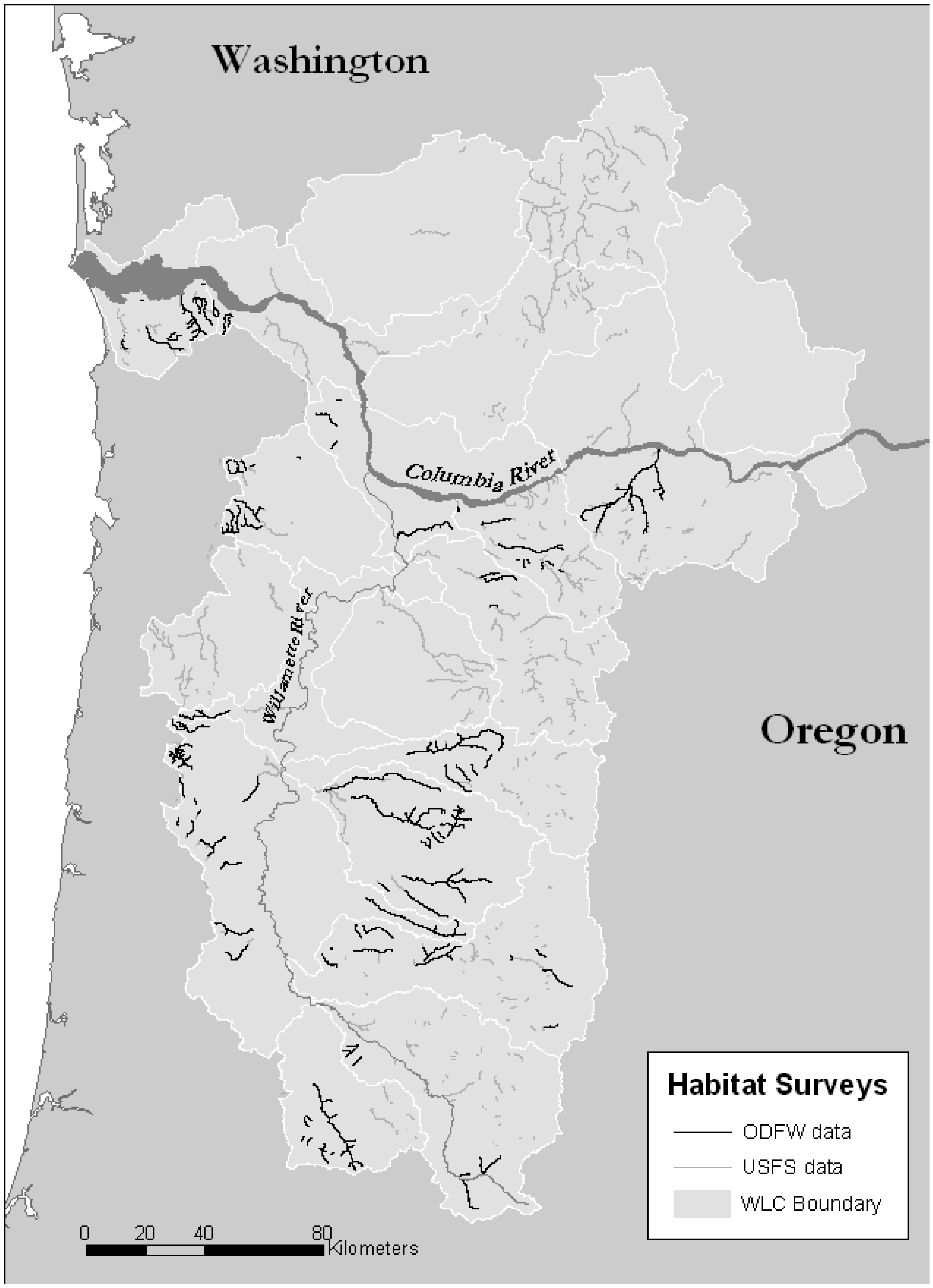

Figure I.1 Reaches in the Willamette/Lower Columbia domain with existing habitat digital survey data from the Oregon Department of Fish and Wildlife (ODFW) and the U.S. Forest Service (USFS). The ODFW digital survey data was used for the channel-width modeling. Please note that neither survey includes the mainstem Willamette or Columbia Rivers.

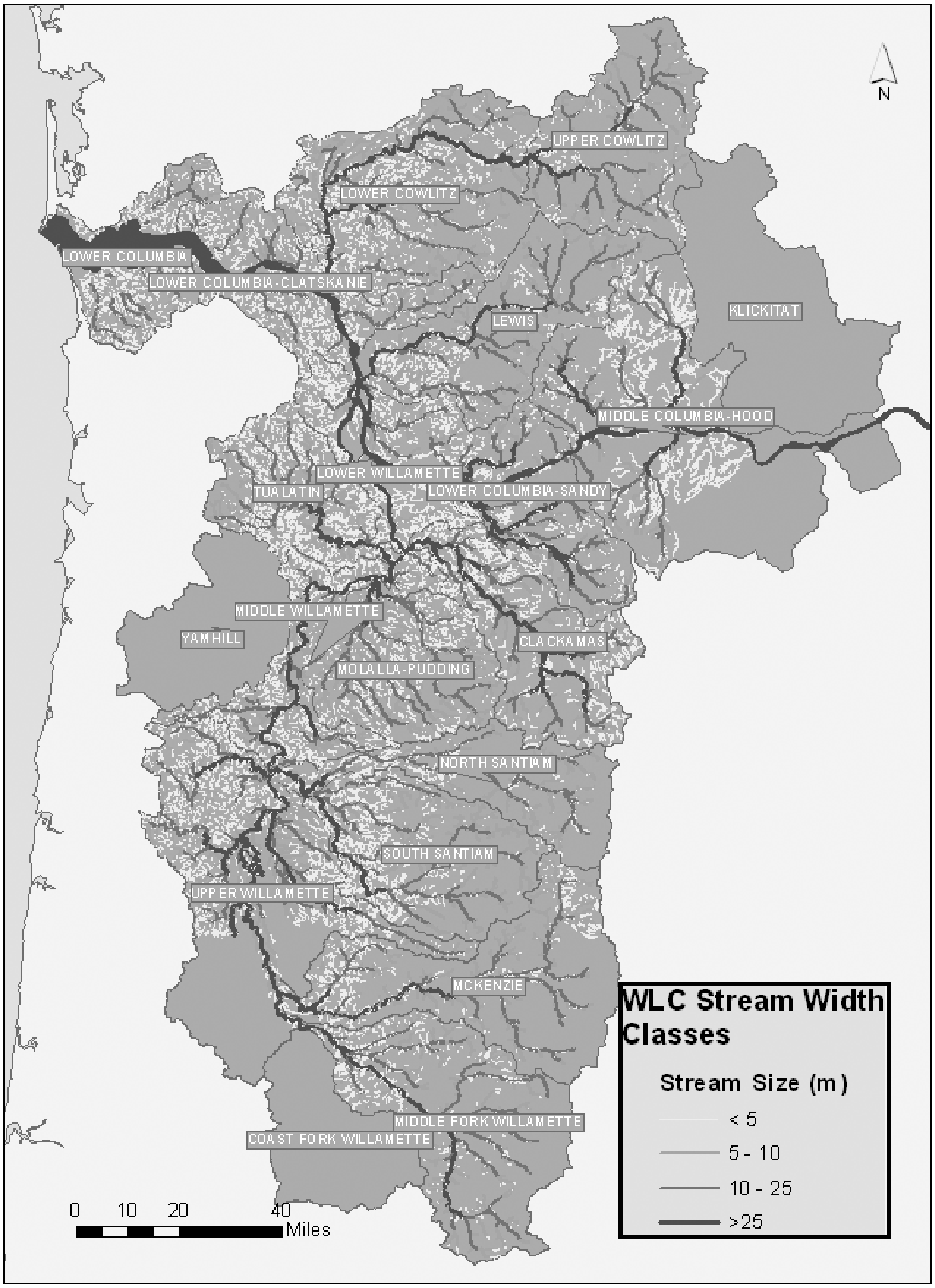

Figure I.2 Modeled widths for the Willamette/Lower Columbia domain, divided into four size classes.

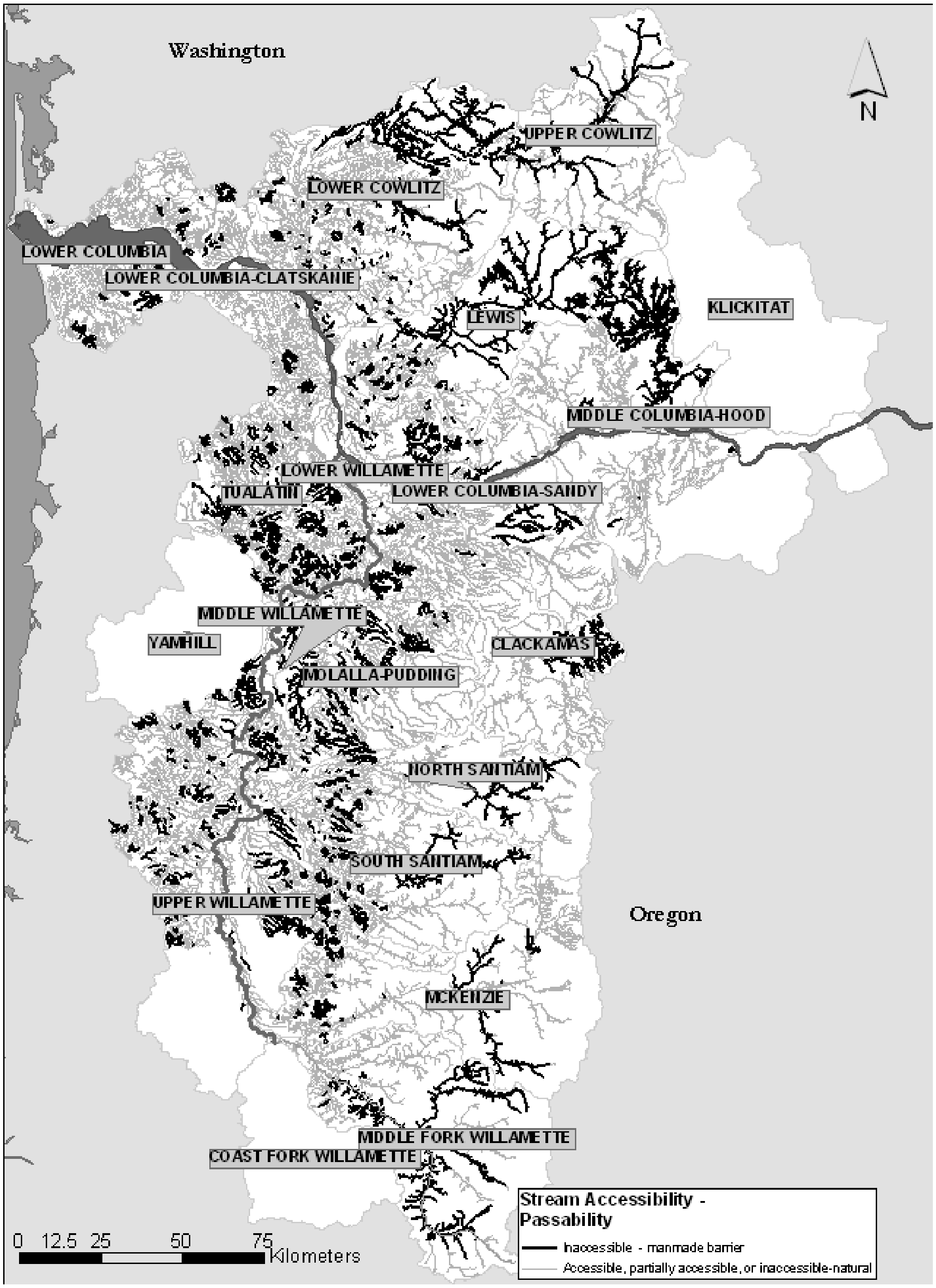

Figure I.3 Stream accessibility and passability for all streams considered in the Willamette/Lower Columbia analysis. Legend describes the various categories of accessibility. Stream kilometers that are inaccessible because of man-made barriers are indicated in black. Light outlines and labels indicate the fourth-field hydrologic basin.

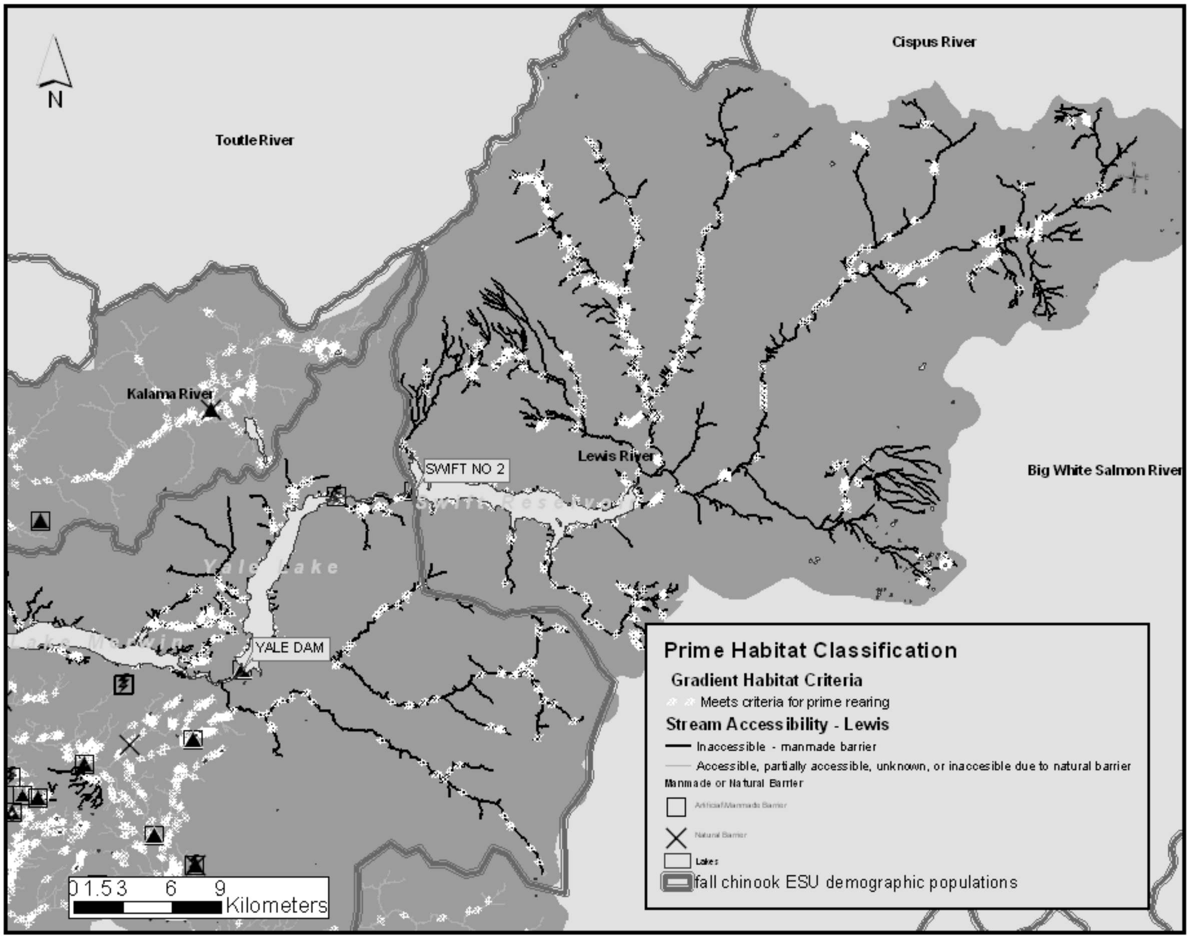

Figure I.4 Example of the identification of prime and possible habitat attributes. Map indicates stream reaches classified as "prime habitat" for chinook rearing or spawning in the Lewis River, based only on defined gradient thresholds. The white symbols indicate patches of streams (reaches) that meet the thresholds. Black streams represent streams inaccessible due to man-made barriers.

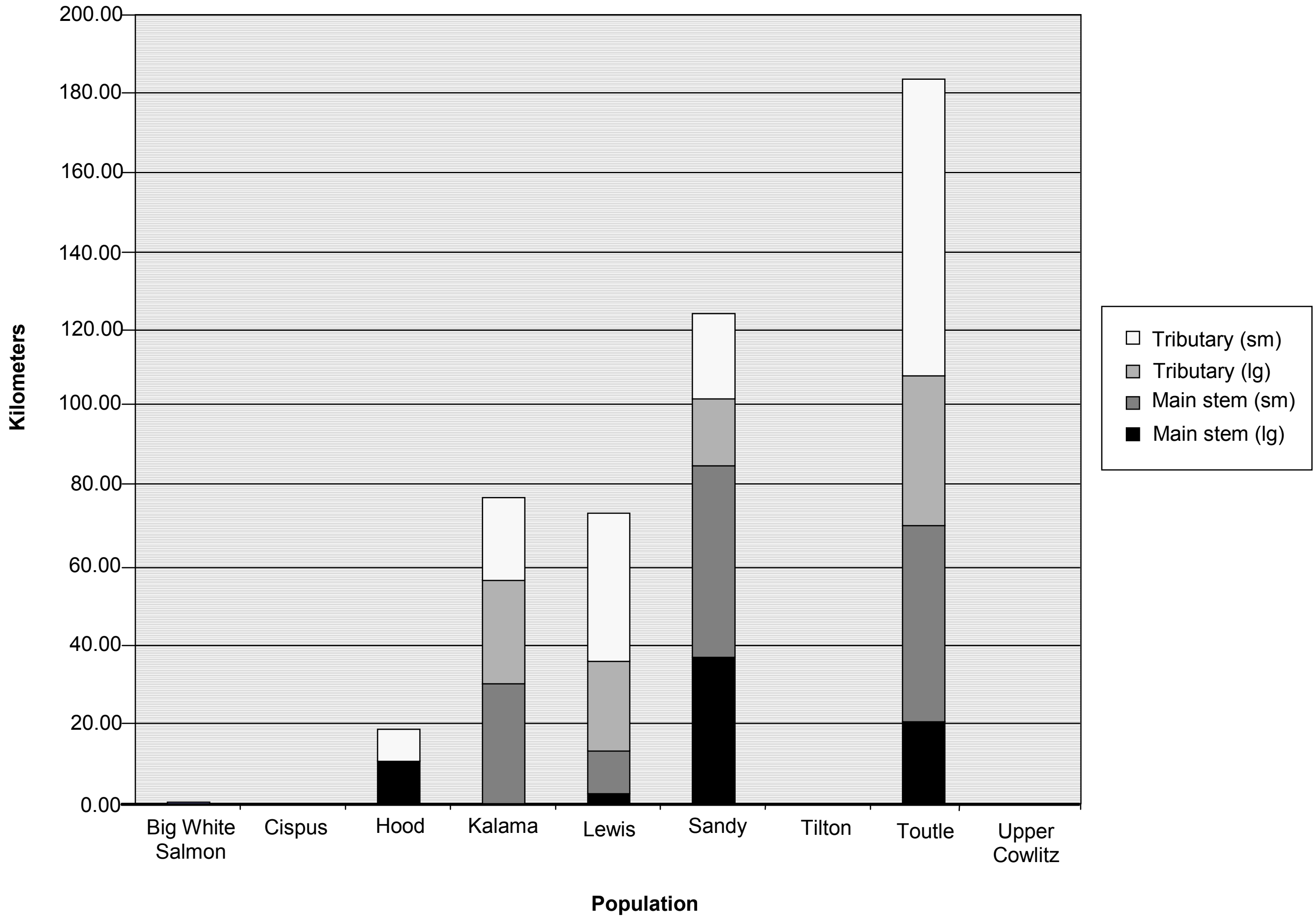

Figure I.5 Currently available kilometers of possible spawning habitat for Lower Columbia spring chinook salmon populations.

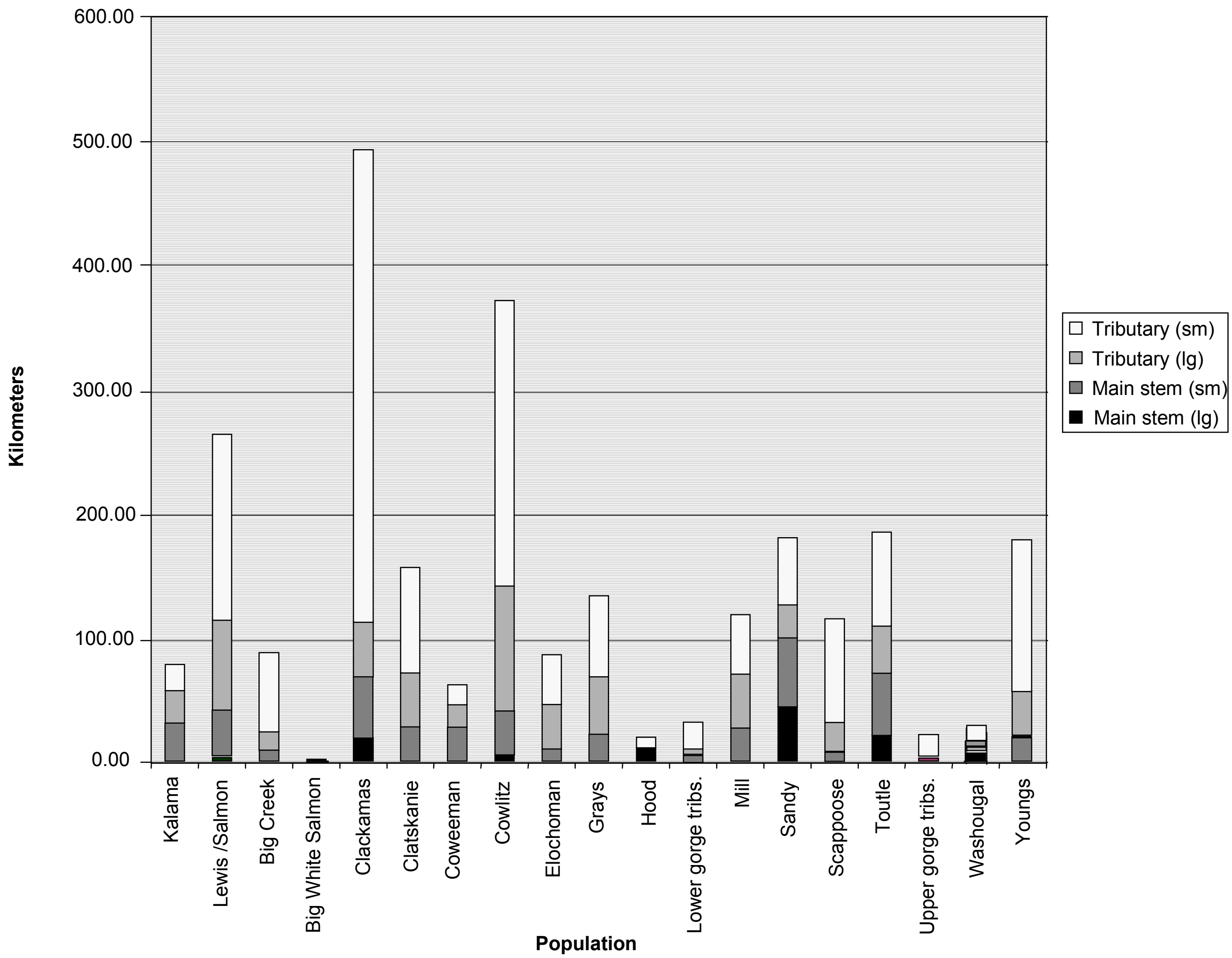

Figure I.6 Currently available kilometers of possible spawning habitat for Lower Columbia fall chinook salmon populations.

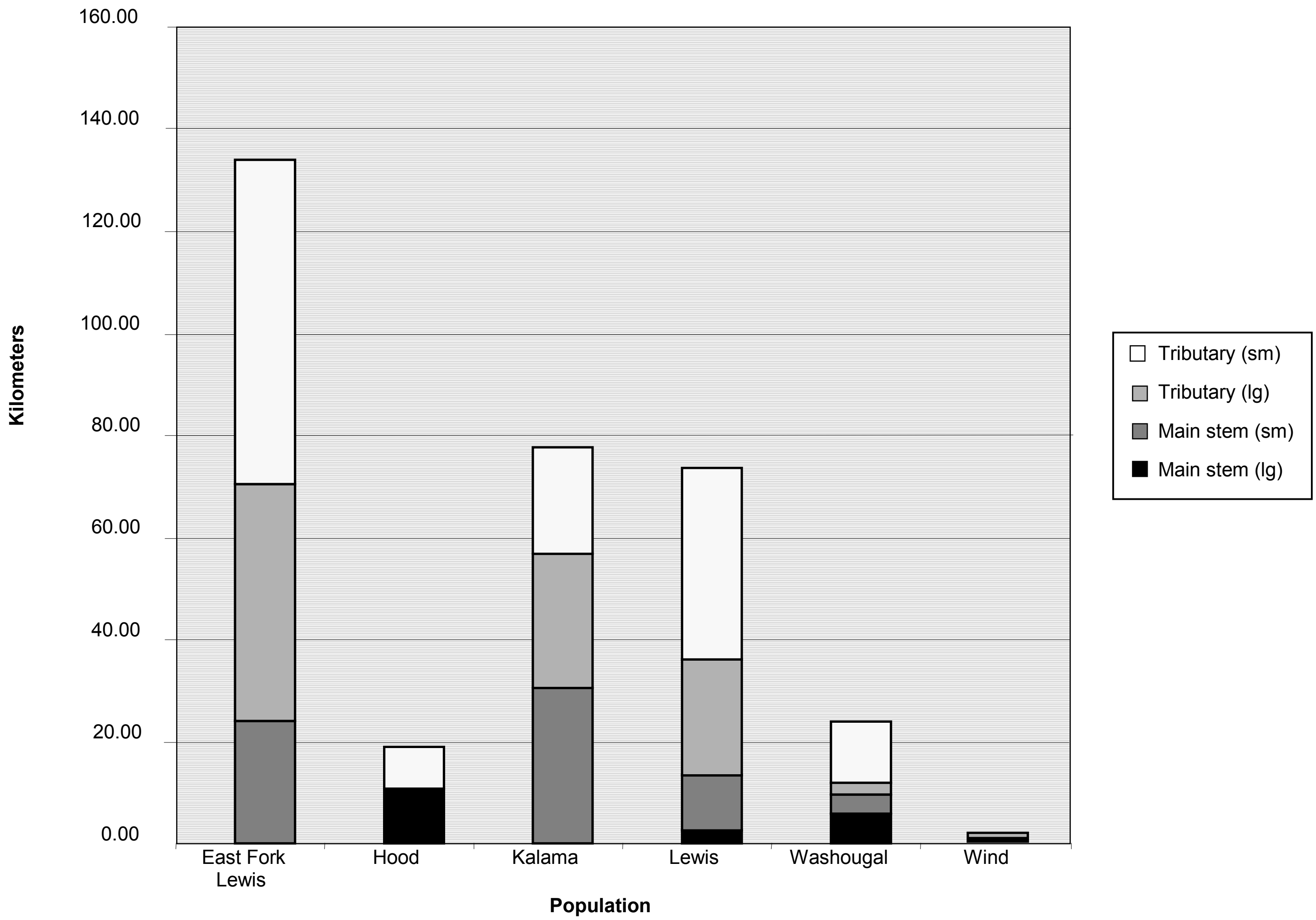

Figure I.7 Currently available kilometers of possible spawning habitat for Lower Columbia summer steelhead salmon populations.

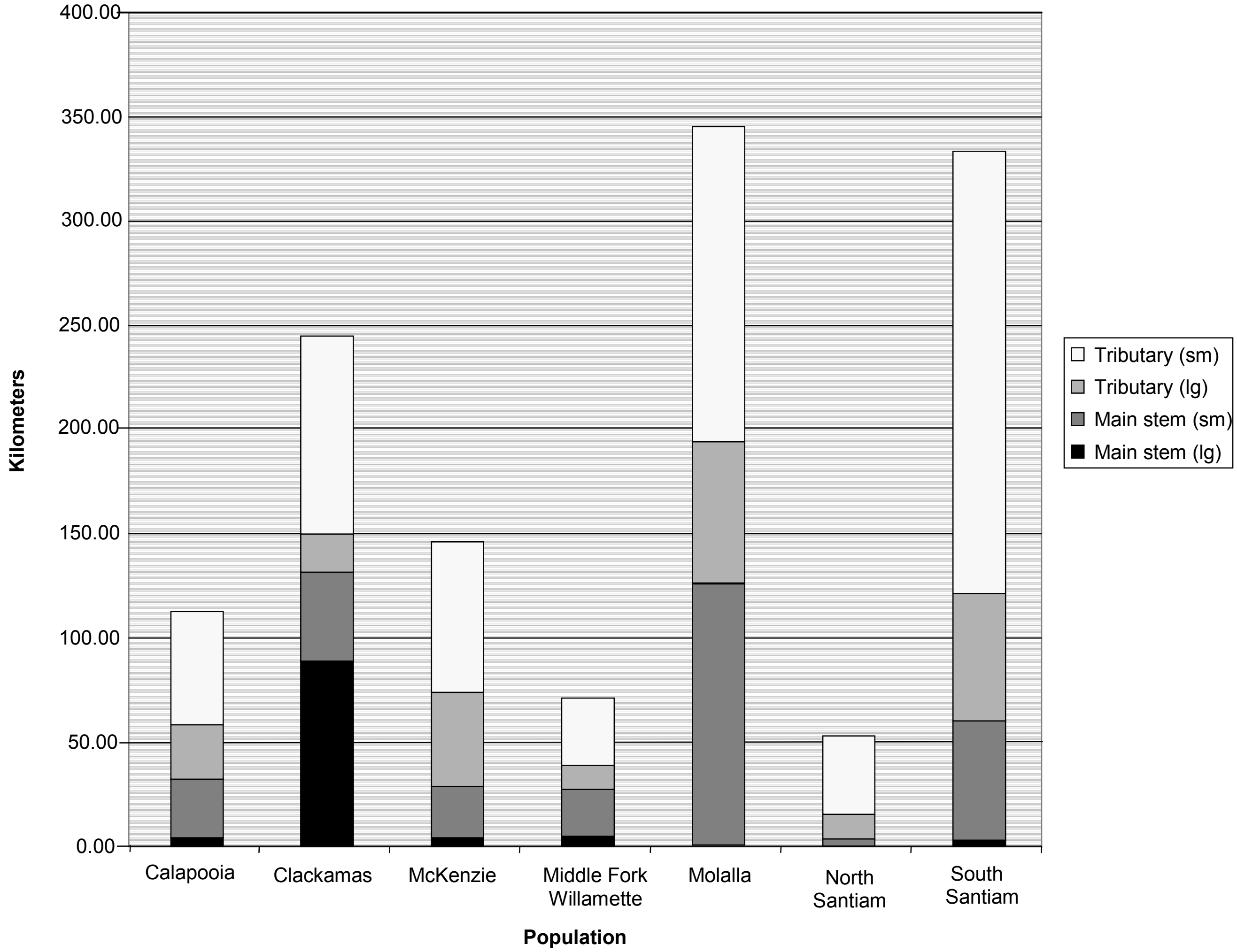

Figure I.8 Currently available kilometers of possible spawning habitat for Willamette spring chinook salmon populations.

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